

[54] **SEALED ASSEMBLY FOR SEPARATION OF BLOOD COMPONENTS AND METHOD**

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[22] Filed: **Apr. 25, 1972**

[21] Appl. No.: **247,386**

[52] U.S. Cl. **210/84, 210/109, 210/516, 210/DIG. 23**

[51] Int. Cl. **B01d 21/26**

[58] Field of Search **210/83, 84, 359, 210/109, DIG. 23, 514-518**

[56] **References Cited**

UNITED STATES PATENTS

3,508,653	4/1970	Coleman	210/DIG. 23
3,661,265	5/1972	Greenspan	210/359
2,279,273	4/1942	Riachall	210/518
539,779	5/1895	Shugerman	210/515
3,693,804	9/1972	Grover	210/359

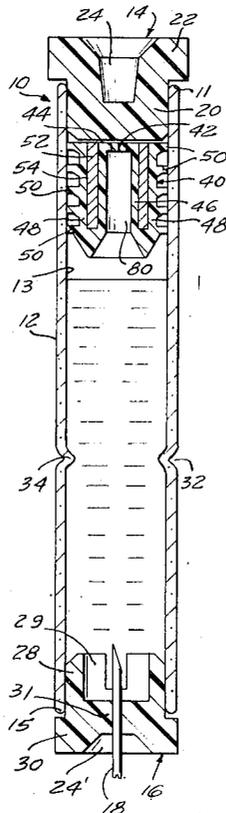
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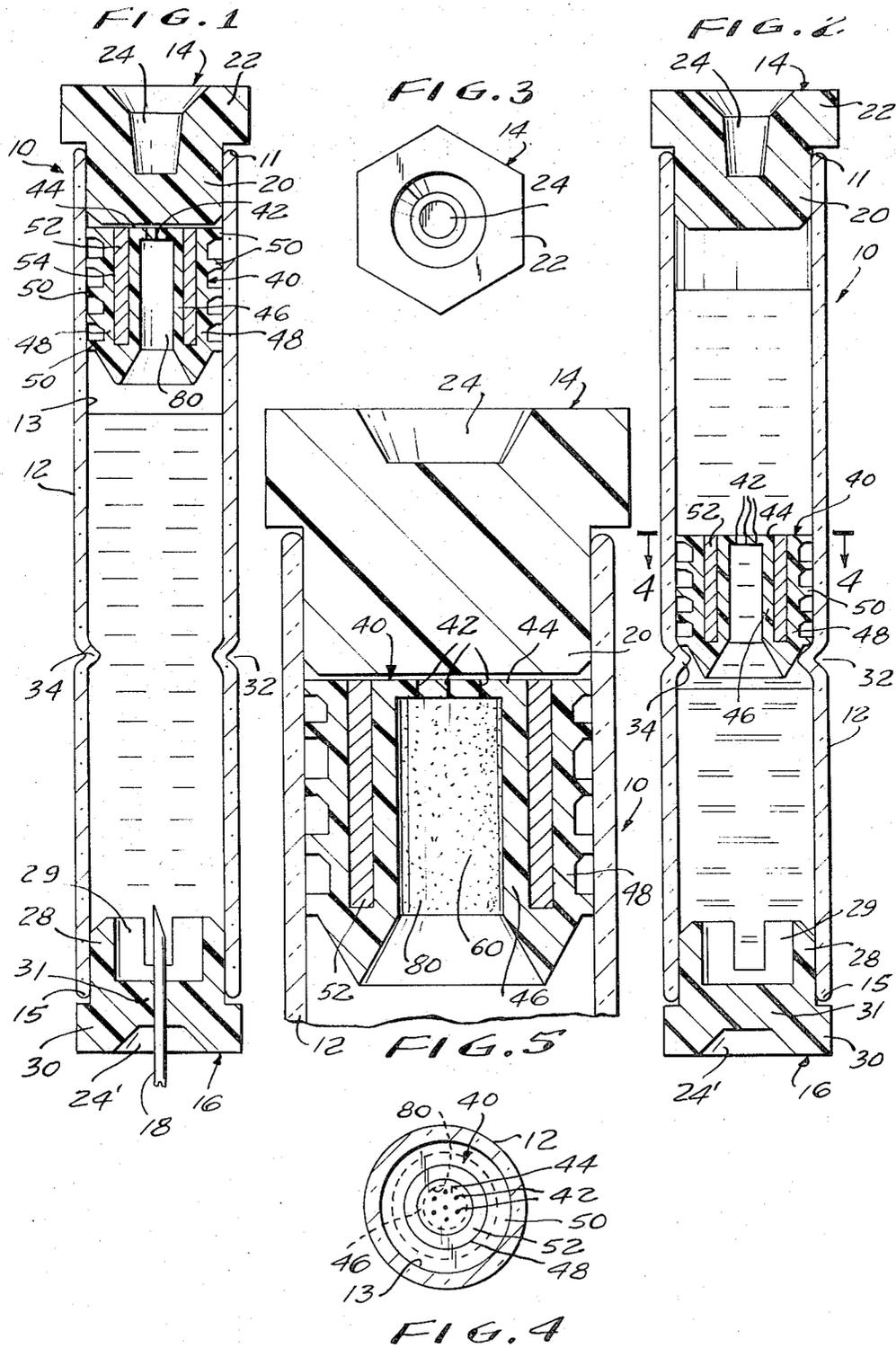
[57] **ABSTRACT**

A self-contained fluid separator assembly is disclosed capable of separating blood into its component parts

of plasma or serum, the light phase, and the cellular portion, the heavy phase. The assembly comprises a container having at least one open end for receiving blood for subsequent separation and a closure sealing the open end of the container, the closure being formed of a self sealing elastomeric material which is penetrable by a pointed hollow needle through which the blood to be separated is conducted into the container. A piston is slidably disposed in the container with its outer surfaces in sealing contact with the inner surfaces of the container. Pressure responsive valve means is provided on the piston which is normally closed when there is a minimum pressure differential on each side of the piston and the valve automatically opens in response to a substantial pressure differential so that when the container is subjected to centrifugal force the blood first separates into its light phase and heavy phase and the valve means automatically opens with the light phase passing through the valve means and the piston moves down through the light phase while retaining sealing engagement with the inner surfaces of the container. Positive stop means is provided on the container between its ends so that the piston as it moves through the light phase will contact the stop means and stop at a predetermined distance above the closure bottom of the tube means whereupon the pressure differential is terminated and the valve means automatically closes to provide an impervious barrier between the separated light and heavy phases of the blood.

17 Claims, 5 Drawing Figures





SEALED ASSEMBLY FOR SEPARATION OF BLOOD COMPONENTS AND METHOD

BACKGROUND OF THE INVENTION

It is known to separate blood into its component parts by centrifugation particularly employing a sealed container such as is disclosed in U.S. Pat. No. 2,460,641. This patent discloses a container having a closure at its open end which is capable of being penetrated by a pointed hollow needle through which blood passes into the container. The clinical laboratories have used this device to collect a blood sample for subsequent separation into a light phase, i.e., the serum or plasma, and the heavy phase, i.e., the cellular portion. The light phase is then decanted from the cellular portion by any conventional means, for example, the use of a syringe fitted with a cannula or a pipette or the like.

An apparatus also employed for the separation of blood is disclosed in U.S. Pat. No. 3,508,653. This patent discloses a self-contained assembly, having a stopper, for separation of body fluid such as blood in which a deformable piston is disposed in the container and is positioned initially adjacent the stopper. After the container is filled with blood the assembly is centrifuged and the blood is separated into its light and heavy phases. Then, increased centrifugal force is applied to the container, the seal between the inner glass surface of the container and piston is broken, the piston is deformed and moves down through the light phase with the light phase passing upward solely between the outer surfaces of the piston and the inner surfaces of the container. When the piston reaches the interface between the light phase and the heavy phase, the piston movement is stopped, the force is terminated, and the seal is re-established between the inner surface of the glass container and the resilient piston to establish a barrier between the two phases. Other devices known to the art are generally the filtration device which separates blood into its component phases such as disclosed in U.S. Pat. Nos. 3,481,477 and 3,512,940.

SUMMARY OF THE INVENTION

The invention generally contemplates the provision of a self-contained sealed fluid separator assembly capable of separating blood into its component parts of plasma or serum as the light phase and the cellular portion as the heavy phase and establishing a sealed barrier therebetween without the necessity of opening the container or decanting the separated light phase from the heavy phase.

It is an object of the invention to automatically separate blood into its component phases by simply subjecting the self-contained assembly to centrifugal force so that upon completion of the centrifuging operation an impervious barrier separates the light phase from the heavy phase of the blood. The assembly is capable of withstanding rough handling through the mails, inversion of the container without remixing the component phases and preventing various chemical constituents in the light phase from leaking into and mixing with the heavy phase or vice versa. It is also an object of the invention to provide an assembly which is adapted for use on conjunction with other blood sampling devices for obtaining samples to be centrifuged without the necessity of employing special equipment. Another object, in an alternative form of the invention is to pass the light

phase of the blood through a filter associated with the pressure responsive valve means. It is a further object of the invention to provide a self-contained assembly for separating blood into its component parts which is inexpensive to manufacture, simple to assemble and easy to use.

The separator assembly for separating blood into its component parts of plasma or serum, the light phase, and cellular portion, the heavy phase, is a self-contained unit which requires only that a sample of blood to be separated be provided within the container. The container is formed having at least one open end which is adapted to receive blood for separation into its component phases. A closure is mounted in the open end for sealing the container, this closure being formed of a self-sealing elastomeric material which is penetrable by a pointed hollow needle through which blood to be separated is conducted into the container. A piston is slidably mounted in the container having its outer cylindrical surfaces in sealing engagement with the inner surfaces of the container. Pressure responsive valve means is disposed on said piston and is normally closed when there is a minimum of pressure differential on the two sides of the piston. The valve means automatically opens in response to a substantial pressure differential so that when the container is subjected first to moderate centrifugal force, the blood separates into its light phase and heavy phase and when the centrifugal force is substantially increased thereafter the valve means automatically opens with the light phase passing up through the valve means while the piston moves down through the light phase and the piston retains its sealing engagement with the inner surfaces of the container. A stop means is formed on the container and disposed a predetermined distance from the bottom of the container which is remote from the piston in its initial position so that the piston when moving through the light phase is caused to stop when it reaches the stop means; the pressure differential is terminated and the valve means automatically shifts from the open position to the closed position to provide an impervious barrier between the separated light phase and heavy phase of the blood. Thereafter, the centrifuging is terminated and the separated sample is ready for subsequent testing.

For a better understanding of the invention reference is had to the drawings which illustrate the preferred embodiments of the invention herein.

FIG. 1 is a sectional elevational view of the separator assembly illustrating a pointed cannula penetrating one of the closures through which blood is introduced into the container prior to separation.

FIG. 2 is a view similar to FIG. 1 illustrating the separation of the blood into the light phase and heavy phase with the piston engaging the stop means.

FIG. 3 is an end view of the assembly of FIG. 1 as viewed from the top.

FIG. 4 is a sectional view taken along the lines 4—4 of FIG. 2.

FIG. 5 is a fragmentary sectional view of the container of FIG. 1 having a modified piston with filter mounted therein.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

For a better understanding of the invention herein a description of the drawings of the illustrative embodiments is had, particularly with respect to the embodiments shown in FIGS. 1 through 4.

In FIG. 1, the separator assembly 10 comprises a tubular member or container 12 having mounted in each of the open ends 11 and 15 closures 14 and 16. Closures 14 and 16 are made of a self-sealing elastomeric material such as rubber. Closure 16 is capable of receiving cannula 18 penetrated therethrough as illustrated in FIG. 1 for conducting blood into the container. When the cannula is removed the closure is resealed with no loss of blood passing through the penetration portion as illustrated in FIG. 2.

Closure 14 is formed having a depending cylindrical body portion 20 and a flanged head portion 22 integrally formed therewith. Body portion 20 has a diameter slightly greater than the internal diameter of the container 12 so that closure 14 when mounted into end 11 provides an interference fit to seal the end. Head portion 22 is shaped in the form of a hexagon (as shown in FIG. 3) and is slightly greater in diameter than body portion 20 which permits the assembly to be positioned on its side without danger of rolling.

Stopper 16 has a cylindrical body portion 28 and an integrally formed cylindrical head portion 30 having an axial recess 24'. Body portion 28 has an annular recess 29 to provide a self-sealing penetrable zone 31 to facilitate insertion of cannula or pointed hollow needle 18 with minimum force while maintaining a sealed closure. As noted above, stopper or closure 14 as well as 16 is inserted into ends 11 and 15 in compression to maintain ends 11 and 15 of container 12 in sealed gas tight engagement.

Tubular member or container 12 is formed preferably of glass but any other suitable material may be employed. Intermediate ends 11 and 15 of tubular member 12 is an annular groove 32 which forms a stop constriction means 34 as a part of the inner surfaces of container 12. Thus, as piston 40 moves from the initial starting position illustrated in FIG. 1 to the terminal position after the separation of the light phase from the heavy phase as shown in FIG. 2, the piston comes to rest at the stop means 34 formed by annular groove 32 of container 12. It is not necessary to take special precautions concerning the density of the piston with respect to the density of the blood, provided the piston has greater specific gravity, since the piston will automatically come to rest at stop means 34 when the increased centrifugal force is applied to the assembly. The seal of the piston with respect to the inner surfaces of the container is constant throughout its travel from its initial position of FIG. 1 to its terminal position of FIG. 2.

Piston 40 comprises a tubular metal insert 52 which is mounted in annular recess 54 of piston 40. Metal insert 52 is preferably made of stainless steel or other rigid, chemically inert material having a specific gravity substantially greater than blood. Piston 40 is formed of elastomeric material and is provided with annular recess 54 which is dimensioned to receive tubular member 52 in an interference fit so that no air space remains in annular recess 54.

The elastomeric portion of piston 40 comprises an outer wall 48 and spaced therefrom is inner wall 46 in which their respective wall surfaces define annular recess 54. Formed integrally with wall 48 are a plurality of radially spaced resilient sealing rings 50 which contact the inner wall surface 13 of container 12 in sealing engagement. Piston 40 when mounted in container 12 will maintain sealing contact with inner wall 13 of container 12 throughout its path of travel within container 12. During the centrifuging operation when increased speed is used piston 40 is subjected to centrifugal forces which start to move it downwardly. This movement establishes a pressure differential on the two sides of the top wall or diaphragm portion 44 of piston 40. The diaphragm 44 is made of relatively thin, stretchable or resilient material and lies adjacent and against stopper 14 in its initial position as seen in FIG. 1. Diaphragm 44 is made of a resilient material and is provided with a plurality of normally closed apertures 42 extending therethrough. Wall portion 46 of piston 40 defines an axial annular recess so that as the assembly is being subjected to increased centrifugal force the light phase which is separated from the blood will pass into annular recess 80. Also, since the centrifugal force acting on piston 40 will generate a force greater than the force of the light phase being exerted against the diaphragm 44 apertures 42 will automatically open and will enable the light phase liquid to pass upwardly through the opened apertures and enable piston 40 to move from its initial position of FIG. 1 to its final position of FIG. 2 while maintaining sealing engagement with the inner wall 13 of container 12. When piston 40 stops its movement in container 12 and comes to rest on stop means 34, the fluid pressure differential on the two sides of diaphragm 44 is substantially eliminated and aperture valve means 42 automatically closes even though the assembly is being subjected to centrifugal forces.

Piston 40 as noted above includes tubular insert 52 which is mounted in the annular recess 54 with an interference fit with no air space therearound. Also, when piston 40 is subjected to centrifugal forces the radial outward thrust force of the increased pressure of the liquid in recess 80 is restrained by tubular insert 52 and will not be transmitted to resilient sealing rings 50 which would cause a major increase of friction between the piston 40 and the interior of glass tube 12 so that piston 40 may be prevented from sliding down to stop 34. Tubular insert 52 as noted above has such a specific gravity that it, plus the elastomeric piston together, have a specific gravity greater than blood and when subjected to centrifugal forces provide a large downward thrust, more than sufficient to overcome the friction of the multiple seal rings 50 of the piston relative to the glass tube plus the added work of opening the resilient aperture valve means. The elastomeric portion of piston 40 is preferably made of rubber.

As illustrated in FIG. 2, piston 40 has completed its travel within container 12 and is stopped from further movement in container 12 by stop means 34 and valve means 42 are closed. Also, a portion of the light phase remains above the separated heavy phase and is not utilized as part of the separated light phase.

In FIG. 4 the top plane of piston 40 is shown at its position at stop means 32. Resilient seal ring 50 is shown in sealing engagement with wall 13 of container 12 with walls 46 and 48 of piston 40 defining the annular recess

for tubular insert 52. At the central portion of piston 40 is diaphragm 44 and apertures 42 in the open position which illustrates the automatic valve means formed in piston 40 in the open position even though centrifuging is being continued.

Referring now to the embodiment illustrated in FIG. 5 which illustrates an optional alternative form of piston 40 which provides filter element 60 mounted in annular recess 80. In all respects in FIG. 5, the container 12, closure 14 and piston 40 are identical to FIG. 1 and all corresponding parts are similarly numbered. Filter 60 may be made of any suitable filter material chemically inert to blood and capable of filtering serum or plasma. Such a material may be asbestos or glass wool, a plastic foam having interconnecting passages, paper or other suitable fibrous or particulate material. The main purpose for employing filter 60 is to remove any fibrin or partially formed fibrin material from passing through valve means 42.

When operating the separator assembly of the invention herein it is preferred that the assembly be evacuated so that when cannula 18 penetrates closure 16 blood will fill container 12 without requiring the use of an air vent. It is also contemplated to provide a separator assembly suitable for use with the blood collecting assembly disclosed in U.S. Pats. Nos. 2,460,641, 3,469,572 and 3,494,352. It is important when filling the assembly 10 that blood be introduced into container 12 through the stopper 16 mounted on the bottom of the container to obviate the possibility of having blood cells trapped between the piston 40 and stopper 22 which will later separate to form the chamber where the light phase will be collected thus contaminating the light phase with blood. If the assembly is evacuated it is obvious blood will fill the space between closure 16 and the piston 40.

After cannula 18 is withdrawn and container 12 is filled with blood the assembly is placed in a centrifuge and the blood is separated initially employing moderate centrifugal forces which do not cause the piston to move from its initial position. This precipitates or separates the blood cells or blood clot into the tube portion below constriction stop means 34. Thereafter the rotational speed of the centrifuge is increased which causes a substantial downward thrust on the piston. As the piston starts to move it increases the hydrostatic pressure in the liquid ahead of it and stretches the diaphragm and valve means 42 automatically opens and the piston moves downwardly through the light phase with the light phase passing up through the valve means. Piston 40 maintains sliding and sealing engagement with the inner wall 13 of container 12. The piston completes its movement when it engages stop means 34 and terminates the pressure differential at the bottom and top of the diaphragm and automatically closes the resilient aperture valve means even while the assembly is still subjected to centrifugal forces as illustrated in FIG. 4. Before centrifuging is terminated diaphragm 44 establishes an impervious barrier between the light and heavy phases of the blood when valve means 42 automatically closes on piston 40.

Then centrifugal forces are terminated and the separated blood sample is ready for use. As desired, the serum or plasma can be taken from one end and/or the concentrated red cells can be taken from the other end.

While variations of the invention herein may be had, the objectives of the invention have been illustrated and described.

I claim:

1. A self-contained fluid separator assembly, capable of separating blood into its component parts of plasma or serum and cellular portion, comprising:
 - a. a container having at least one open end which is adapted to receive blood for subsequent separation into a light phase and a heavy phase;
 - b. a closure sealing the open end of the container, the closure being formed of a self-sealing elastomeric material which is penetrable by a cannula through which blood to be separated is conducted into the container;
 - c. a piston having a specific gravity relatively greater than the cellular portion of the blood and slidably mounted in the container and having means on an outer surface in sealing engagement with an inner surface of the container;
 - d. pressure responsive valve means associated with said piston, said valve means being normally closed when there is a minimum of pressure differential on different portions of the valve means and which automatically opens in response to a substantial pressure differential so that when said container is subjected to moderate centrifugal force the blood separates into its light phase and heavy phase but the piston stays in the upper portion of the container, and subsequently when increased centrifugal force is used the valve means automatically opens with the light phase passing up through the valve means enabling the piston to move down through the light phase while retaining sealing engagement with the inner surfaces of the container; and
 - e. mechanical stop means on the container whereby the piston when moving through the light phase will stop a predetermined distance from one of the ends of the container followed by termination of the differential pressure which permits the valve means to automatically shift from an open position to a closed position to provide an impervious barrier between the separated light phase and heavy phase of the blood.
2. The self-contained fluid separator of claim 1 wherein the piston includes a rigid tubular sleeve mounted in a generally tubular outer body portion formed of an elastomer and having at least one sealing ring on its outer portion for sealing engagement with the inner walls of the container and a diaphragm forming a wall across one end of the generally tubular elastomeric sleeve and having apertures formed therein which are normally closed but which automatically open when subjected to a substantial pressure differential on the opposite sides of the diaphragm.
3. The self-contained fluid separator of claim 1 wherein the stop means on the container is an annular groove interposed between the ends of the container forming an annular constriction of the inner surface of the container so that said piston is prevented from passing the stop means when subjected to centrifugal forces.
4. The invention in accordance with claim 1, wherein a plurality of spaced annular sealing rings are on the periphery of the piston and in sealing engagement with the interior of the container.

5. The invention in accordance with claim 1, wherein the valve means is independent of the piston sealing means.

6. A piston adapted for use for separating fluid into a light phase and a heavy phase in a self-contained fluid separating assembly comprising:

a. a body portion having sealing means formed on its outer peripheral walls for maintaining sealing engagement with the inner walls of the fluid separator assembly;

b. a rigid tubular sleeve mounted in the body portion of said piston and having an interference fit and pressure responsive valve means mounted on the piston which is normally closed when there is a minimum of pressure differential on the surfaces of the valve means and which opens automatically in response to a substantial pressure differential so that when the container is subjected to moderate centrifugal force the fluid separates into its light phase and heavy phase and when the container is subjected to increased centrifugal force the valve means automatically opens with the light phase passing through the valve means enabling the piston to move down through the light phase while retaining sealing engagement with the inner surfaces of the container, the rigid tubular sleeve in combination with the body portion having a specific gravity greater than the heavy phase of blood.

7. The piston of claim 6 wherein an axial recess is formed in the body portion, the closed end of the recess defining an end wall portion having the pressure responsive valve means formed therein.

8. The piston of claim 7 wherein the end wall portion is formed of an elastomeric material having at least one aperture formed therein, said aperture being normally closed where there is a minimum pressure differential on the two sides of the end wall and which automatically opens in response to a substantial pressure differential.

9. The piston of claim 6 wherein the body portion of said piston is formed having a filter means associated therewith and in fluid communication with said pressure responsive valve means whereby said filter means is adapted to remove particulate material from the light phase as the piston moves downwardly therethrough.

10. The invention in accordance with claim 4, wherein a plurality of spaced annular sealing rings are on the periphery of the piston and in sealing engagement with the interior of the container.

11. The invention in accordance with claim 4, wherein the valve means is independent of the piston sealing means.

12. A method for the sealed separation of blood into its light phase of serum or plasma and its heavy phase of cellular portion with a sealed container assembly comprising:

- a. introducing blood in said assembly through a self-sealing closure mounted in one end of the assembly remote from a piston slidably mounted in sealing engagement with the inner surface of the container and said piston having pressure responsive valve means mounted thereon with the piston having a greater specific gravity than the red cells of blood and being disposed above the blood to be separated;
- b. subjecting the assembly to differing amounts of centrifugal force whereby with moderate centrifu-

gal force the pressure responsive valve means is normally closed and there is a minimum of pressure differential on the two sides of the valve means and with substantially increased centrifugal force the valve means automatically opens in response to substantial pressure differential which enables the piston to move downwardly through the light phase while the light phase passes up through the valve means; and

c. stopping the piston by applying a restraining force by a stop interiorly of the container and at a point above the separated heavy phase and automatically shifting the pressure responsive valve means from an open condition to a closed condition.

13. The method of separating blood into its light phase, consisting of serum or plasma, and its heavy phase, consisting of concentrated red cells, comprising the steps of:

a. introducing the blood sample into a sealed and evacuated blood container comprising a double ended tube sealed at each end by an elastomeric closure and with a slidable piston adjacent the closure opposite the closure through which the blood is introduced;

b. centrifuging the blood container first at a moderate speed and with the end of the blood container with the piston uppermost so that the piston does not slide downwardly but the blood does separate into its heavy phase at the bottom and the light phase at the top;

c. then centrifuging the blood container at a substantially increased speed whereby the slidable piston, having a specific gravity substantially greater than either the serum or red cells, overcomes the sliding and sealing friction and moves downwardly thereby increasing the hydrostatic pressure of the liquid ahead of it, this increased pressure automatically opening a normally closed valve means which is associated with the piston, which allows the light phase to pass up through the valve means and permits the piston to descend to a mechanical stop means;

d. stopping the descent of the piston by the stop means despite the continued action of centrifugal force, and after stopping the piston, the light phase liquid continues to flow upwardly through the valve means thereby diminishing the hydrostatic pressure ahead of the piston until the differential pressure is so diminished that the valve means automatically closes again, thereby providing a permanent sealed barrier between the light phase and the heavy phase of the blood.

14. A fluid separator assembly capable of separating blood into its component parts of plasma or serum and cellular portion comprising:

a. a container for receiving blood and having at least one open end which is adapted to receive a closure for sealing the open end of the container;

b. a piston having a specific gravity relatively greater than the cellular portion of the blood and slidably mounted in the container and having means on an outer surface thereof for sealing engagement with the inner surface of the container;

d. pressure responsive valve means associated with the piston, said valve means being normally closed and being adapted to automatically open when subjected to a predetermined pressure when the piston

is slidably moving within the container and which automatically close when the piston ceases movement to isolate a substantial amount of the plasma or serum from the cellular portion; and

e. stop means interiorly of the container for cooperating with the piston in assuring the isolation of the light phase of the plasma or serum from the cellular portion.

15. A self-contained fluid separator assembly, capable of separating blood into its component parts of plasma or serum and cellular portion comprising:

a. a tubular container having two open ends;

b. resilient closure means adapted to close said ends, with at least one of said closure means capable of being penetrated by a cannula for filling with blood;

c. a slidable piston having a specific gravity relatively greater than the cellular portion of blood and being in sealed relation with the inside surface of said container, said piston being located initially adjacent the closure opposite to that through which the cannula may penetrate, the space within the tube and between the penetrable closure and the piston forming a first chamber for receiving blood from the cannula;

d. said slidable piston being adapted to remain in the upper part of the container while moderate centrifugal force is used to precipitate the cellular portion of the blood with the displaced plasma or serum flowing into the upper portion of the first chamber;

e. the piston being further adapted, when subjected to increased centrifugal force, to slide downwardly through the plasma or serum thus forming a second chamber within the tubular container and between the piston and the closure opposite to the closure previously penetrated by the cannula, said second chamber being filled with plasma or serum only;

f. the piston being further adapted to automatically stop and form a permanent sealed barrier in the plasma or serum slightly above the heavy phase, without any blood cellular material ever passing through the closure opposite the closure penetrated by the cannula, or through the second chamber, or through the piston, whereby any risk of contamination of plasma or serum by the cellular material of the blood is eliminate; and

g. stop means for cooperating with the piston in assuring the isolation of the cellular portion of the blood from the liquid.

16. A method for the sealed separation of blood into its light phase of plasma or serum and its heavy phase of cellular portion within a sealed container assembly comprising:

a. introducing blood through a first closure at one end of a tubular container having a second closure at its opposite end, with a slidable sealing piston adjacent said second closure and having a specific gravity relatively greater than the cellular portion of blood, the inflowing blood filling a first chamber consisting of the space between the first closure, the interior surface of the container, and the piston;

b. subjecting the container of blood to moderate centrifugal force whereby the heavy cellular portion of the blood is precipitated downwardly and the lighter plasma or serum is displaced upwardly within the first chamber, while the piston stays in the upper portion of the container;

c. then subjecting the container to increased centrifugal force whereby the piston is caused to slide downwardly and the plasma or serum flows up into a second chamber created by the downward movement of the piston and comprising the space between the piston, the second closure, and the interior surface of the container; and

d. then stopping the piston automatically by stop means interiorly of the container above the cellular portion of the blood and permanently sealing the piston, whereby the blood, lighter and heavier phases having been sealed in separate chambers, and the risk of contamination of the light phase in the second chamber has been eliminated by preventing any blood cellular material from ever having passed through the second closure, or through the second chamber, or through the piston.

17. A self-contained fluid separator assembly, capable of separating blood into its component parts of plasma or serum and cellular portion, comprising:

a. a container having at least one open end which is adapted to receive blood for subsequent separation into a light phase and a heavy phase;

b. a piston having a specific gravity greater than the cellular portion of blood slidably mounted in the container so that when said container is subjected to centrifugal force the blood separates into its light phase and heavy phase, and the piston is adapted to slide in the container and eventually locate near the interface of the light and heavy phase;

c. said piston having means on an outer surface in sealing engagement with an inner surface of the container;

d. means associated with said piston for permitting passage of plasma or serum; and

e. stop means within the container for stopping the piston near the interface and at a predetermined distance from one of the ends of the container.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,779,383 Dated December 18, 1973

Inventor(s) Waldemar A. Ayres

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

IN THE CLAIMS:

Claim 10, line 1, change the numeral "4" to --- 6 ---

Claim 11, line 1, change the numeral "4" to --- 6 ---

Claim 15, line 47, the word "eliminate" should be

--- eliminated ---

Signed and sealed this 9th day of July 1974.

(SEAL)

Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents