June 8, 1965 F. J. TENCZAR, JR 3,187,750

MULTIPLE BAG BLOOD STORAGE UNIT

Original Filed Sept. 26, 1957

Fig. 1.

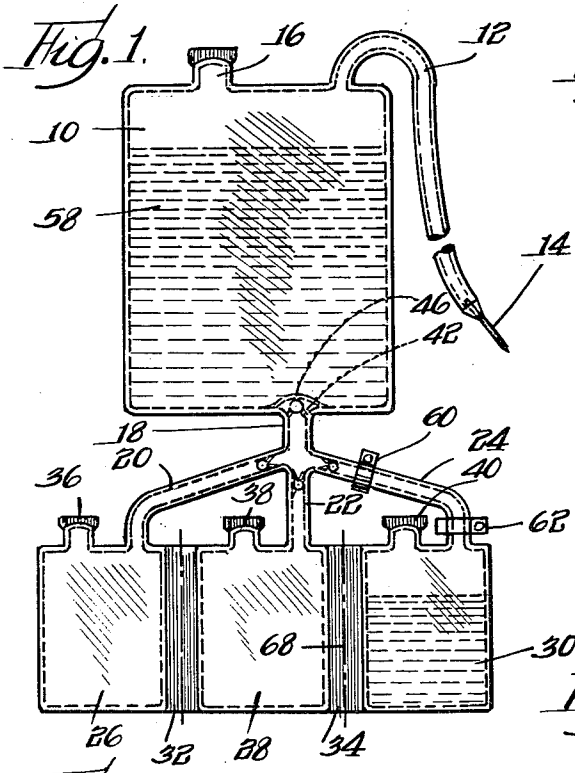


Fig. 2.

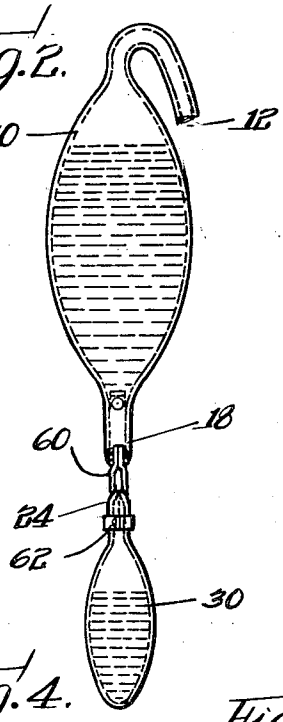


Fig. 3.

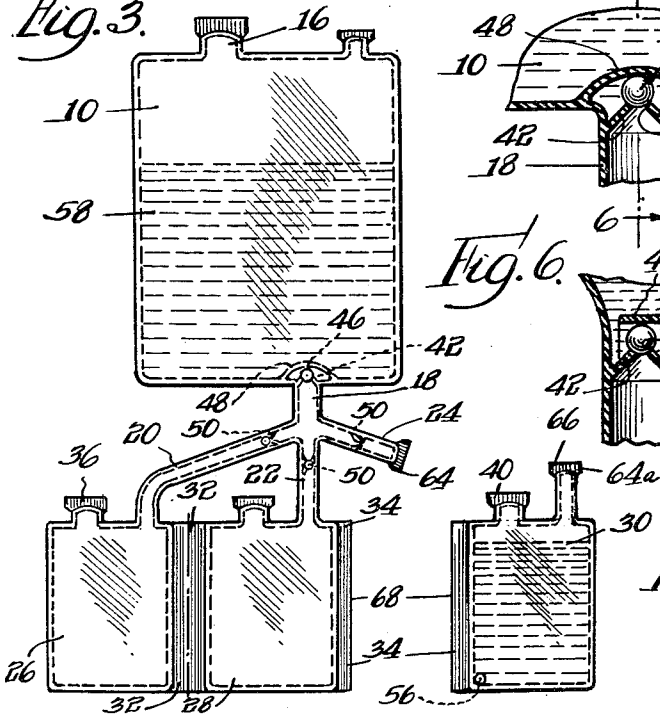


Fig. 4.

Fig. 5.

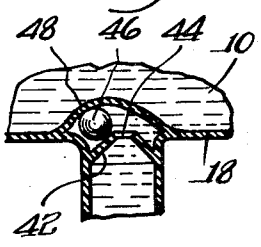


Fig. 6.

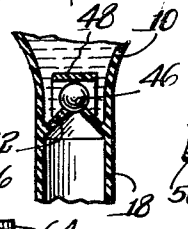
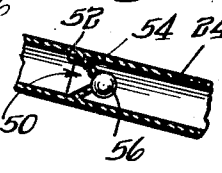


Fig. 7.



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United States Patent Office 3,187,750 Patented June 8, 1965

3,187,750

MULTIPLE BAG BLOOD STORAGE UNIT

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Continuation of application Ser. No. 686,412, Sept. 26, 1957. This application Jan. 15, 1963, Ser. No. 251,688
13 Claims. (Cl. 128—272)

This application is a continuation of my application, Serial No. 686,412, filed September 26, 1957, now abandoned.

This invention is concerned with the transfer of human blood, and more particularly with a package unit for use in blood banks and the like.

It is now common practice to store human blood in what are known as blood banks. Blood for human transfusion can be collected and stored in sterile containers containing an anticoagulant for periods up to three weeks. It is common practice to extract 500 cc. of blood from a donor at one time and this is usually kept in a single container. As will be understood, it would be extremely irritating to a donor to have to provide several smaller donations of blood totaling 500 cc. Although 500 cc. is often used for adult transfusions, there are many instances when this much blood is not needed. For example, in pediatrics, only 125 cc. of blood may be used. In other instances, it may be desired to use only the blood plasma, or only the red blood cells. However, withdrawal of a fraction of the blood in a sterile container with subsequent storage of the remaining blood is not permitted. Once part of the blood has been withdrawn, all of it must be withdrawn and used within a very short time or the remaining blood must be discarded. As will be apparent, this often leads to a rather profligate use of a precious commodity.

This invention is designed to overcome this extravagant waste of human blood and an object thereof is to provide a sterile integral unit containing a suitable anticoagulant and having provision for separating a given quantity of stored blood into smaller quantities, either of whole blood or of fractionated blood, without in any way breaking the seal or disturbing the sterility of the unit.

More specifically, it is an object of this invention to provide a sterile blood storage unit wherein a relatively large storage vessel is hermetically interconnected with one or more smaller vessels whereby the blood can be subdivided without disturbing the sterility of the unit.

Furthermore, it is the object of this invention to provide a blood storage unit as outlined above wherein the smaller vessels are detachable from the larger vessel without disturbing the sterility thereof whereby the various quantities of blood in the several vessels can be used independently over relatively widely-spaced intervals.

For many years blood was stored only in glass vessels or containers. In recent years plastic bags for blood storage have come into use. The plastic bags have many advantages, particularly in that they can be collapsed and expanded, and hence do not require any venting to avoid unwanted buildup or decrease of air pressure as in a glass container. Furthermore, the plastic bags are not susceptible to breakage as are glass containers. This invention is concerned primarily with blood storage units of the plastic bag type.

Additional objects, advantages, and aspects of the invention will be apparent from the following description when taken in connection with the accompaying drawings wherein:

FIG. 1 is an elevational view of a blood storage unit in accordance with the invention herein;

FIG. 2 is a side view of the unit of FIG. 1;

FIG. 3 is a view similar to FIG. 1 and showing part of the blood withdrawn from the main storage vessel into one of the smaller storage vessels;

FIG. 4 is a fragmentary enlarged view showing the valve at the exit of the main storage vessel or bag;

FIG. 5 is a view similar to FIG. 4 showing the valve in open position;

FIG. 6 is a longitudinal sectional view through the valve as taken along the line 6—6 in FIG. 4; and

FIG. 7 is a fragmentary enlarged view of one of the valves in the branch tubes leading to one of the smaller storage bags.

Referring now in greater particularity to the drawings, and first to FIGS. 1–3, there will be seen a relatively large or master storage container or "mother" bag 10 made of plastic. The bag 10 is provided with the usual integral tubing 12 terminating in a needle 14 for extracting blood and, as will be understood, when the bag 10 has been filled with blood, the tubing 12 is sealed between the needle and the top edge of the bag. The bag also is provided with the usual outlet 16 comprising a puncturable sealing section whereby a needle may be inserted into the bag for withdrawal of blood.

At the bottom of the bag 10 there is provided a plastic tube 18 integral with the bag and having a plurality of integral branches, there being three such branches shown in the illustrative embodiment, respectively identified by the numerals 20, 22, and 24. Integrally connected to the tubes 20, 22, and 24 is an equal number of smaller or "daughter" bags 26, 28, and 30, integrally interconnected with one another by webs 32 and 34. Each of the daughter bags is provided with a sealed section, respectively identified as 36, 38, and 40, having a puncturable section for withdrawal of blood through a needle.

Various valves preferably are provided for sealing the bags from one another. Thus, at the entrance to the tube 18 joining the bag 10 there is provided a valve seat 42 having an orifice 44 therein closed by a ball 46. This ball initially is held tightly in seated position such as by partially fusing the valve seat 42 to the ball or by securing the ball by means of a suitable adhesive. However, the seal between the valve seat 42 and the ball can be broken by squeezing the ball through the sides of the bag 10. A strap 48 of the same flexible plastic material as the remainder of the bags and tubes may be placed across the ball as shown in order to hold the ball in the vicinity of the valve seat whereby it can be moved back into sealing position by squeezing it through the sides of the bag.

Each of the branch tubes 20, 22, and 24 is provided with a valve 50, these valves being of similar construction and hence having the same identifying numeral. One of the valves 50 is shown in connection with the branch tube 24 on an enlarged scale in FIG. 7. It will be seen that the valve includes a valve seat 52 having an orifice 54 sealed by a relatively small ball 56. The seal is on the downstream side, as opposed to the valve seat 42 and ball 46, and the ball 56 initially is held in position by being partially fused or cemented to the valve seat. The ball 56 is substantially smaller than the internal diameter of the tube 24 and hence, when the valve ball is expressed or squeezed from its seat by pinching the tube, the ball will fall to the bottom of the corresponding bag, as 30.

Assuming that the bag 10 has just been filled with blood, as is indicated at 58, the valve ball 46 is on the seat 42 and all of the blood is retained in the bag 10. The tube 12 is heat sealed, by known methods, immediately adjacent the upper edge of the bag and the tube is cut off. The entire unit consisting of the plurality of bags and interconnecting tubes then remains as shown until such time as it is desired to utilize the blood. Suppose it is desired to utilize only one quarter of the blood in the mother bag 10. Thus, assuming the mother bag 10 to be 500 cc., and each of the daughter bags 26, 28, and 30 to be 125 cc.,

the valve ball 46 is expressed from its seat by squeezing through the sides of the bag 10. Similarly, the ball 56 is expressed from its seat to open the valve 50. The blood then will run gravitationally through the tube 18 and the branch tube 24 into the bag 30, and the flow can be augmented by squeezing on the bag 10. When the bag 30 is full, the flow will stop and the valve 46 may be reseated if desired. Clamps 60 and 62 are placed across the branch tube 24, the ball 56 having dropped to the bottom of the bag 30, as shown in FIG. 3. With the clamps in place, the tube 24 can be severed and the ends thereof tied or otherwise suitably sealed. However, it is preferable that the branch tube 24 be fused or heat sealed as at 64 and 64*a*, the branch tube 24 then being cut off across the dividing line 66. The clamps then can be removed. In order to facilitate the fusing at 64 and 64*a*, the inside of the branch tube can be treated so as to be hydrophobic, whereby the blood will readily move away from these surfaces by squeezing of the tube and the inner surfaces of the tube will more readily adhere to one another. The bag 30 then can be separated from the unit by severing along the line 68 through the web 34.

The unit or package at this time has never been opened. Thus, the blood in the daughter bag 30 remains sterile, as does the blood in the mother bag 10 and a slight bit in the tube 18 and remainder of the branch tube 24. Accordingly, the blood 58 remaining within the bag 10 can still be stored up to the usual time limit and can be further subdivided by means of the bags 26 and 28.

As will be apparent, the whole blood can be separated into smaller units, as just described. Greater or lesser numbers of daughter bags can be used, and the size need not be uniform. In addition, the blood can be fractionated by centrifuging the unit, and then by draining the red blood cells into one or more of the daughter bags and by draining the plasma into one or more others of the bags, including retaining some in the mother bag. Furthermore, one of the daughter or accessory bags could have a saline solution introduced thereinto before sealing of the unit. Blood cells thus could be drained into that bag to produce resuspended cells. It will be apparent that a certain amount of blood may remain in the interconnecting tubes and thus the dividing line between plasma and red blood cells may be made to occur within the tubes, thereby avoiding any carry-over in any of the bags.

It is to be understood that the embodiment of the invention as shown and described herein is for illustrative purposes only. Various changes in structure will no doubt occur to those skilled in the art, and are to be understood as forming a part of the invention insofar as they fall within the spirit and scope of the appended claims.

The invention is claimed as follows:

1. A blood storage unit comprising: a hermetically sealed plastic container; a sealable entrance to said container for introducing blood therein; a plurality of additional plastic containers, each being hermetically sealed; conduit means including a main branch conduit hermetically sealed to said first-mentioned container and communicating with the interior thereof, said conduit means further including a plurality of secondary branch conduits individually hermetically sealed between said main branch conduit and said additional containers providing flowwise communication between said first-mentioned container and said additional containers; and selectively openable means connected to each of said branch conduits, initially closing said conduits and individually selectively opening one or more of said conduits permitting blood to flow from said first-mentioned container to a selected additional container in continuation of the hermetic seal of said containers.

2. A blood storage unit comprising a hermetically sealed plastic container, a sealable entrance to said container for introducing blood thereinto, a plurality of additional plastic containers which are hermetically sealed, a plurality of plastic tubes respectively leading from the first hermetically sealed container to the remaining hermetically sealed containers, said tubes being hermetically sealed to the containers and said tubes being individually heat sealable, said tubes including a main tube connected to the first plastic container and including a plurality of branch tubes respectively connected to the additional containers, and openable means initially closing said tubes, for opening one or more of said tubes permitting passage of blood from said first container to the corresponding additional containers without disturbing the sealing of the unit, said openable means including means closing the main tube and additional means individually closing the branch tubes.

3. A blood storage unit as set forth in claim 2 wherein each of the tube closing means comprises a ball valve.

4. A blood storage unit as set forth in claim 3 wherein the ball valves in the branch tubes open downstream, whereby upon opening of a valve the ball may pass through the tube into the corresponding additional container.

5. A blood storage unit comprising a hermetically sealed principal plastic container, a sealable entrance to said container for introducing blood thereinto, a plurality of auxiliary plastic containers which are hermetically sealed, and plastic tube means connected in parallel directly interconnecting said principal container with each of said auxiliary containers and hermetically sealed to all of said containers, there being means initially sealing said tube means against blood flow therethrough from said principal container, opening of said sealing means allowing transfer of blood from the principal container to a selected auxiliary container without disturbing the sterility thereof.

6. A blood storage unit system comprising a first hermetically sealed plastic storage container of predetermined volumetric capacity, a sealable supply tube leading to said container for introducing blood thereinto, a marginally disposed normally sealed stub discharge section leading from said first container, a second plastic storage container which is hermetically sealed, said second storage container having a volumetric capacity substantially not less than one quarter the volumetric capacity of the first container, a marginally disposed normally sealed stub discharge section leading from said second container, and a plastic tube providing a passageway of substantially uniform cross section interconnecting said containers and hermetically sealed to both said containers, there being means initially sealing said last named tube against blood flow therethrough, opening of said sealing means allowing transfer of stored blood from the first container to the second container for storage therein without disturbing the sterility thereof, said sealing means being disposed internally of the system and at the juncture of the first container and said last named tube and including relatively shiftable parts shiftable from closed to open position by the manipulation of the plastic.

7. A blood storage unit as defined in claim 6 wherein the relatively shiftable parts of said sealing means comprises a bead valve.

8. A blood storage unit system comprising a first hermetically sealed plastic storage container of predetermined volumetric capacity, a sealable supply tube leading to said container for introducing blood thereinto, a marginally disposed normally sealed stub discharge section leading from said first container, a second plastic storage container which is hermetically sealed, said second storage container having a volumetric capacity substantially not less than one quarter the volumetric capacity of the first container, a marginally disposed normally sealed stub discharge section leading from said second container, and a plastic tube providing a passageway of substantially uniform cross section interconnecting said containers and hermetically sealed to both said containers, there being sealing means disposed internally of the system and at the juncture of said last named tube and said first container initially sealing said last named tube against blood flow

therethrough, opening of said sealing means allowing transfer of stored blood from the first container to the second container for storage therein without disturbing the sterility thereof.

9. A blood storage unit system comprising a first hermetically sealed plastic storage container of predetermined volumetric capacity, a sealable supply tube leading to said container for introducing blood thereinto, a marginally disposed normally sealed stub discharge section leading from said first container, a second plastic storage container which is hermetically sealed, said second storage container having a volumetric capacity substantially not less than one quarter the volumetric capacity of the first container, a marginally disposed normally sealed stub discharge section leading from said second container, and a plastic tube interconnecting said containers and hermetically sealed to both said containers, said last named tube being of substantially uniform cross section along its length and having an unobstructed interconnection juncture with said second container, and sealing means for said last named tube disposed within the system and adapted to be sealed against blood flow therethrough, opening of said sealing means allowing transfer of stored blood from the first container to the second container for storage therein without disturbing the sterility thereof.

10. A blood storage unit as defined in claim **8** wherein said containers are of general rectangular shape and wherein the marginally disposed discharge section of the

first container is along the same wall thereof as the connection to said supply tube, and the marginally disposed discharge section of said second container is along the same wall thereof as the connection to said second tube.

11. A blood storage unit as defined in claim **8** wherein the marginally disposed discharge sections of said first and second containers are similarly made and include facing plastic sheets sealed together hermetically to provide openable sterile discharge passages.

12. A blood storage unit as defined in claim **1** wherein each of said plurality of additional plastic containers is of substantially the same volumetric capacity and of a volumetric capacity substantially less than that of the first mentioned plastic container.

13. A blood storage unit as defined in claim **1** wherein said plurality of additional plastic containers is interconnected by web means separable to facilitate the removability of said containers from each other.

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