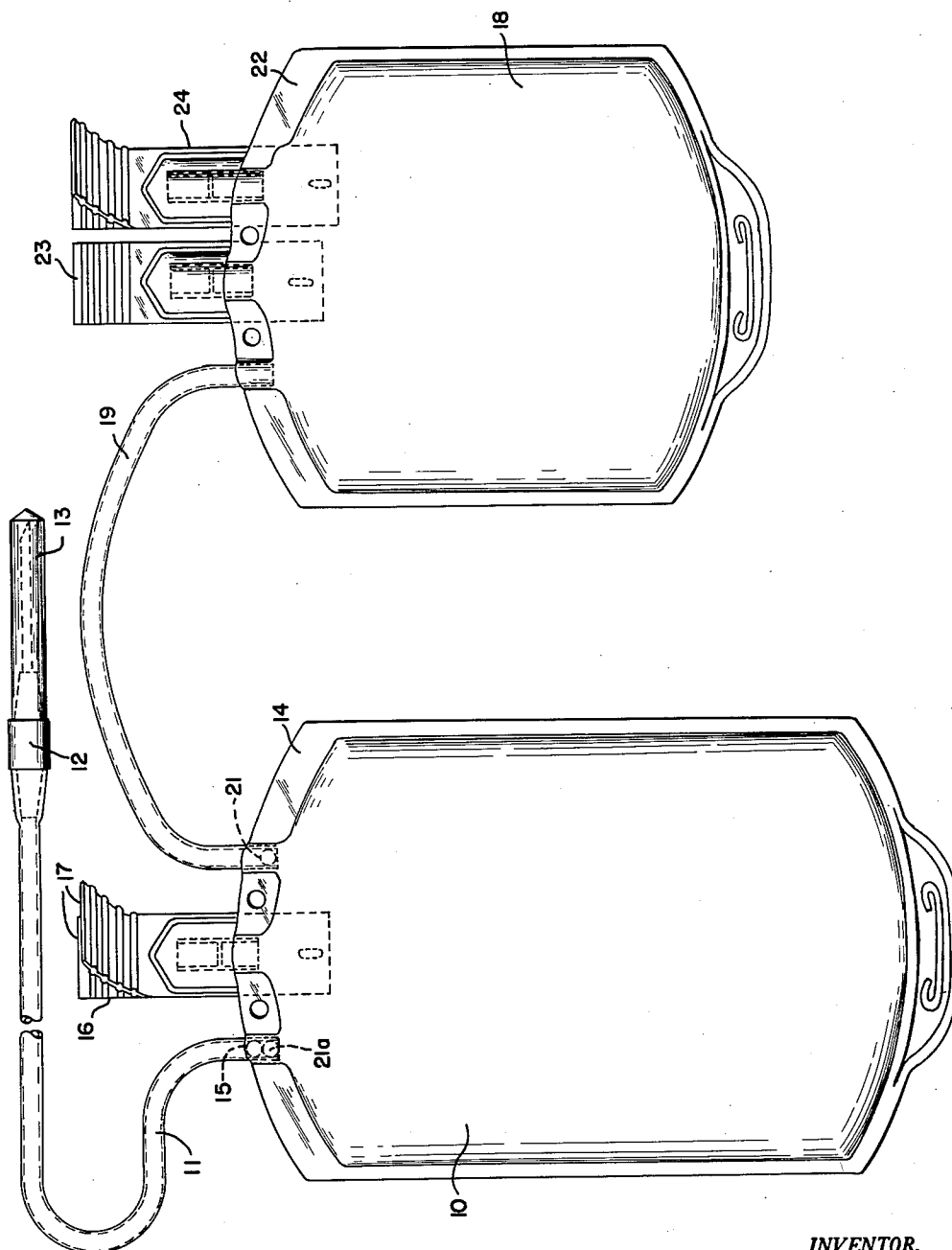


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METHOD OF STERILIZATION

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METHOD OF STERILIZATION

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The present invention relates to a novel method of sterilization. More particularly, it relates to a method of sterilizing collapsible, thermoplastic, multi bag parenteral fluid systems intended for the collection of blood and the subsequent separation of the blood into various components.

Blood is a complex liquid having a number of components of clinically proven value. In various surgical procedures the indicated need may be for a specific component such as plasma, the red cells, the platelets or the leucocytes of blood as opposed to whole blood. For example, separated or packed red cells may be indicated and administered in cases such as chronic anemia to restore a diminished oxygen carrying capacity; for hemophilia the use of fresh or fresh-frozen plasma is indicated to supply labile clotting factors; for burn victims and shock cases requiring the restoration of blood volume liquid or frozen plasma is to be separately employed; and for the control of excessive hemorrhage as in cases of thrombocytopenia the administration of the platelets is specifically indicated.

The administration of whole blood is, of course, still indicated in other cases of hemorrhage or shock, or operations involving extra corporal circulation and the like.

In the past, it has been known to collect blood into a flexible, hemorepellant, thermoplastic collapsible container and then later, if desired, to couple said container to a similar separately serilized, individual container and then to express a given component of blood into said new container (See Gardner et al., Journal of Laboratory and Clinical Medicine, volume 43, pp. 196-207, 1954). This method of component separation presents one very serious disadvantage, namely, that the opening of the collection container to the outside by virtue of the act of coupling, because of the danger of contamination makes it mandatory that the whole blood and its various separate components be used within 24 hours or discarded. Needless to say, the limited supply of human blood makes the conservation of blood or its components a matter of utmost importance.

To avoid the need to discard the unused remainder of the blood and its separated components, completely closed air-free systems have been devised into which blood may be collected and subsequently divided into its components without opening the system to the outside. These systems are comprised of a plurality of individual, flexible, hemorepellent containers connected together and sterilized as a unit. The first of the plurality of containers is basically a blood collection container containing a liquid anticoagulant and equipped with a donor tube. This container is joined to one or more other containers by the flexible lengths of tubing which are clamped off until a component separation is desired.

While these systems do appear to be a satisfactory solution to the problems previously encountered, considerable difficulty accompanies the sterilization, particularly those systems in which one or more of the flexible containers is to be empty of fluid. When such systems are steam sterilized the walls of the empty flexible container because of their thermoplastic nature often stick together so tenaciously that the container cannot be expanded even with the introduction of the separated component. In fact, in many instances the walls cannot be

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parted at all without destroying the closed nature of apparatus.

It has now been discovered, that systems comprised of one or more fluid containing bags such as a blood collection bag and one or more empty containers may be readily sterilized as a single unit by the novel method which comprises taking an unsterile closed unitary system containing fluid in the blood collection container, removing the obstacles to flow throughout the system without opening the system to the outside, expressing sufficient fluid from the original fluid containing containers into the original empty containers to prevent the walls of said empty containers from sticking together during steam sterilization, steam sterilizing said system as a unit, then expressing the fluid in the originally empty containers back into the original fluid containing containers and isolating the fluid in said containers without opening the system to the outside.

The present invention will be better understood from the following description in conjunction with the accompanying drawing which illustrates by way of example preferred embodiments and in which:

FIGURE 1 is an elevational view of a unitary, closed system for blood collection and separation into its components.

In the form of the unitary blood collection and component separation system shown in FIGURE 1, the system comprises collecting or storing means having a flexible collapsible chamber or bag 10 to which is integrally joined a flexible collecting or donor tube 11 of suitable length. The tube 11 provides and mounts at its outer end a rigid cannula or phlebotomy needle 12 which is specially sharpened to minimize tissue trauma. The needle has a double tapered hub over one end of which is seized the end of tube 11 and whose other end has expanded over it a rubber or other resilient cover 13 drawn over the cannula of the needle so as to seal the cannula against contamination.

The collapsible lay-flat construction of the bag 10 may be afforded by juxtaposing sheets or flattening a large tube initially open at the ends, through one of which the inner end of the collecting tube 11 is received before said one end is flattened and fused therearound as at bar seal 14.

The integral donor tube 11 is closed at its inner end by means preferably located within but removable by manipulation from outside and without entering the system, and in this case comprising a hemorepellent-coated steel ball 15 which is over-sized, and so frictionally held in the tube.

Also sealed through the end 14 of the collection bag 10 is a port assembly 16 such as that described in U.S. 2,894,510. The pair of sheet strips 17 are sealed to define a sterile pouch for the port assembly.

The system further comprises one or more component receiving means which comprises at least one more flexible collapsible chamber or bag 18 shown as formed similarly to the first bag 10 and integrally joined thereto by a connecting tube 19 of suitable length. The tube 19 is removably closed adjacent bag 10 by externally manipulable means such as an oversized hemorepellant bead 21.

The tube 19 opens into bag 18 through flat end seal 22 through which are also received a pair of port assemblies 23 and 24. If the system is comprised of more than two bags, one of the port assemblies may either be replaced and a connecting tube similar to tube 19 used to add a third bag or preferably the connecting tube 19 formed with a Y type connector allowing for the connection of the first bag with the second and third bags of the system. Obviously, still more bags may be added without slight additional modification of tube 19.

The described system will be understood to be constructed and prepared in accordance with the teaching

of U.S.P. 2,702,034. More particularly, by integral fabrication from polyvinyl chloride or a similar flexible, elastic, plastic material which is not only tough and transparent, but which offers to the blood only a glossy inert hemorepellant surface to delay coagulation and degradation of blood. The needle and the valve beads 15 and 21 are also coated with a hemorepellant film whereby the apparatus is characterized in its entirety by non-wetting surfaces which prevent or reduce to a negligible amount the sludging of blood cells in storage and improve the plasma in potassium and hemoglobin levels.

The apparatus, as is visible from the drawing, presents a system by which blood may be collected and if desired individual or combinations of blood components separated and isolated from each other and administered without exposing to the outside the remainder of the system's contents.

In manufacture, the bag 10 is formed with the hemorepellant beads 15 and 21 located within. Tubes 11 and 19 are either secured initially to the bag 10 by the heat sealing operation or secured by gluing or the like after the bag has been formed. Bag 18 is then formed with the unattached end of connecting tube 19, heat sealed into communication with its interior. The apparatus at this stage is completely closed except for the opening provided by the free end of tube 11. The bag 18 is then completely collapsed and pressed to exclude all air from said bag into bag 10. Tube 19 is then closed off by inserting the hemorepellant bead 21 in the open end of the tube communicating with bag 10. Bag 10 is then completely collapsed to expel all the air from the remainder of the apparatus. The desired amount of liquid anticoagulant such as 72 ml. of the conventional A-C-D solution per 500 cc. volume bag is then added to bag 10 through tube 11 and the needle and cover applied to the end of tube 11 and the bead 15 used to close off the open end of tube 11, thus obtaining an air-free, unitary closed system.

In the past, the apparatus as manufactured was then steam sterilized as described in U.S. 2,868,616. Invariably after being exposed to sterilization temperatures the empty bag 18 possessed points at which the normally separated container walls were more or less sealed together. These obstructions to the normal expansion of bag 18 could sometimes but not always be removed by carefully pulling apart the walls manually so as to not rip open the desirably closed system.

In the practice of the present invention the closed, unitary apparatus of FIGURE 1 prior to sterilization is handled in the following manner. The bead 21 closing off the end of tube 19 is forced out of position and preferably manipulated into position 21a in tube 11. Sufficient liquid anticoagulant solution is then forced through tube 19 into bag 18 to hold the walls of bag 18 apart. At the same time, of course, sufficient solution is retained in bag 10 to prevent its walls from being sealed together.

The apparatus is then steam sterilized by placing the apparatus in an autoclave having a vent, and supplying steam and gas to the autoclave. The autoclave atmosphere is then agitated to insure complete steam-gas mixture and to have steam-gas contact with the apparatus. The autoclave steam supply is then regulated to establish a sterilizing temperature for a sterilizing time (250° F. for about 30 minutes). The autoclave gas supply and the autoclave vent are regulated to establish a substantial balance across the walls of the containers of the partial pressure of the gas in the autoclave with that within the container. A description of the method in detail and

diagrams of several apparatus for this process are described in detail in U.S. 2,868,616.

Upon completion of the sterilization process the apparatus is restored to its original form by expressing all the fluid out of container 18 through the tube 19 and then closing off tube 19 once again with bead 21. The thus resulting apparatus is sterile, air-free and ready for the collection of blood and its separation into components.

While for purposes of illustration the novel method has been described in terms of a two-container system it is readily apparent that the invention is not so restricted. It will be likewise apparent that other forms of closing off the tube 19 may be used, such as externally located clamps may be used with the apparatus if desired. These and still other changes may be made without departing from the spirit and scope of the present invention.

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

1. The method of sterilizing a unitary, closed, collapsible thermoplastic multicontainer system, at least one container of which contains fluid and at least one container of which is empty of fluid and which is further provided with means for obstructing flow throughout the system which comprises taking said system and removing the obstructions to flow throughout the system, expressing sufficient fluid from the fluid containing containers into the originally fluid empty containers to maintain the walls thereof in spaced apart relation, steam sterilizing said apparatus, and then expressing substantially all the fluid from said originally fluid empty container back to the originally fluid containing container and restoring the obstructions to flow throughout the system.

2. The method of claim 1 in which the means for obstructing flow throughout the system are located within but manipulatable from without said system.

3. The method of claim 2 in which said means is a hemo-repellant bead.

4. The method of sterilizing a unitary, closed, thermoplastic collapsible multicontainer system for the collection and handling of blood, said system comprised of at least one empty and one fluid containing containers and removable means preventing flow from said fluid containing to said empty containers which method comprises removing the means preventing flow among the containers, expressing fluid into the originally empty containers while retaining sufficient fluid in said originally fluid containing containers to maintain the thermoplastic walls of all the containers in a spaced-apart relationship, steam sterilizing said apparatus, and then expressing substantially all fluid from said originally empty containers and replacing the means preventing flow from said fluid containing to said empty containers.

5. The method of sterilizing a unitary, closed thermoplastic multicontainer apparatus for the collection and handling of blood, said apparatus comprised of at least one empty and at least one fluid containing container and means for isolating the fluid in said fluid containing container which method comprises introducing sufficient fluid into each of the containers of the system to maintain the thermoplastic walls of said containers in a spaced-apart relationship, steam sterilizing said apparatus, then expressing substantially all the fluid from a container it is desired to ultimately have empty into a container which is desired to ultimately contain fluid and finally isolating substantially all the fluid in said fluid containing container.

No references cited.