

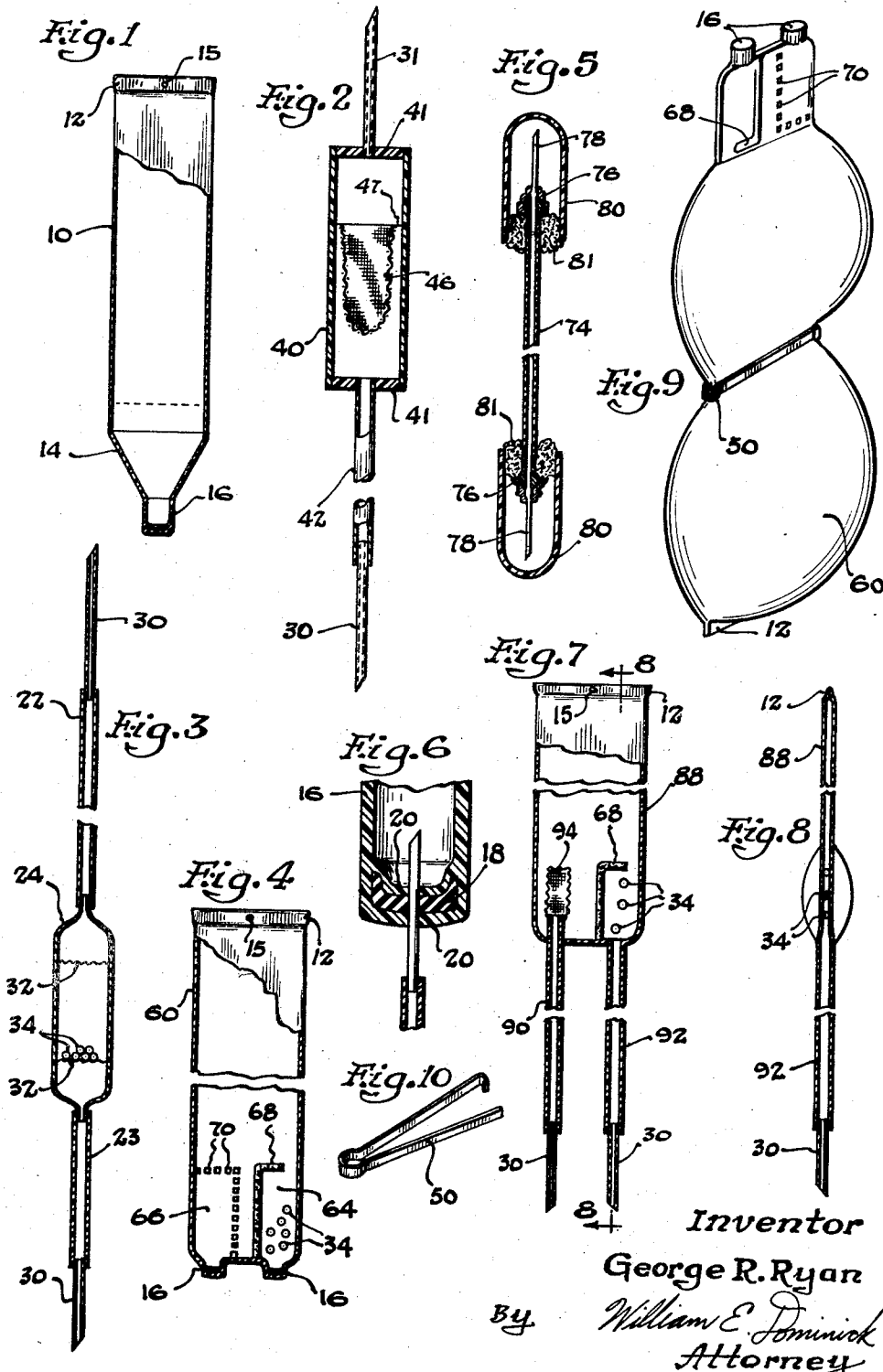
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TRANSFUSION APPARATUS

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TRANSFUSION APPARATUS

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5 Claims. (Cl. 128—214)

The present invention relates to new and improved transfusion apparatus and more particularly to apparatus for blood and blood plasma transfusions.

Transfusions of blood are very old in medical science, but comparatively recent innovations have led to the indirect transfusion techniques in common use today. That is, instead of transfusing blood directly from the donor to the receiver, the blood is taken from the donor and stored in a container until it is subsequently needed, with storage times up to as long as three weeks. Blood plasma has also recently come into wide-spread use, subsequently necessitating changes in transfusion technique.

Generally, the apparatus currently available for both blood and plasma transfusions, consists of a formidable array of equipment, including several bottles, aspirators, air filters, etc., and in instances comprises dozens of separate pieces and parts necessary to make a single transfusion. Such apparatus is obviously very expensive and difficult to handle, requiring special technical personnel with specialized training.

I have invented a new and improved apparatus for blood and blood plasma transfusions, which eliminates much of the standard equipment, and also eliminates the need for a replacement of fluid by air in the containers. The apparatus of the invention comprises a flexible bag of synthetic plastic which inflates and deflates automatically as fluid enters or leaves the bag, eliminating the contact of the fluid with air. In the simplest form the bag has integral receiving and dispensing tubes, and is a complete one-piece transfusion apparatus.

It is important in emergency blood transfusions that the apparatus be simple and immediately available. The apparatus of my invention may be packaged and sterilized at the source of manufacture as a complete ready-to-use transfusion unit. Further, by using the apparatus of my invention, blood plasma may be separated and injected into the receiver directly from the donor, without using the complicated equipment for the separation and handling of blood plasma as must now be done with present methods.

Referring to the drawings:

Fig. 1 is a section of a device according to the invention;

Fig. 2 is a section of an injection tube;

Fig. 3 is a section of a blood collection tube;

Fig. 4 is a section of a modified device;

Fig. 5 is a section of a double cannula injection tube;

Fig. 6 is a section of the needle adapter of Figs. 1 and 4;

Fig. 7 is a section of another modified device;

Fig. 8 is a section on line 8—8 of Fig. 7;

Fig. 9 is a perspective of the device of Fig. 4, indicating one of its positions of use;

Fig. 10 is a view of the clamp of Fig. 9.

The device of Fig. 1 comprises a main tube portion 10 hermetically sealed at the upper end 12, and sealed at the opposite end by converging walls 14 integral with projection serving as a needle adapter 16. I prefer to

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make the bag of transparent or translucent flexible material to allow the contents of the bag to be observed. The needle adapter 16 is integral with the wall 10, and comprises a soft, pliable, elastic cup or core 18, completely embedded in plastic layers 20, which layers are integral with the side walls of the adapter 16. For the ordinary transfusion about 500 cc. of blood is used, and it is preferable to employ a bag of about 600 cc. capacity. A suitable size is about two inches in diameter and about 10 inches long.

The blood collection tube (herein called bleeding tube) of Fig. 3 consists of two lengths of plastic tubing 22 and 23 with a glass bulb insert 24 connected between them. Cannulae 30 are attached to each of the free ends of the plastic tubing. The glass bulb 24 has two screenlike elements 32, holding anticoagulant pills 34 inside the glass bulb.

The dispensing tube of Fig. 2 has a plastic cannula 31 for insertion in the needle adapter 16. The filter cell 40 is a tube of hard plastic. The screen 46 is flared at 47 and thrust into position. Then the end plugs 41 are cemented to the tube 42 and cannula 31. Then they are cemented into the ends of the cell 40 to complete the assembly. The tube 42 has a cannula 30 suitable for use on a patient. The bleeding tube and the dispensing tube are sufficiently long to allow the bag to be lowered or raised above or below the donor or receiver.

In use, one of the cannulae 30 of the donor tube of Fig. 3 is inserted through the needle adapter 16 of the transfusion bag 10, as shown in Fig. 6. The cannula at the other end is then inserted into the vein of the donor, and the bag is placed somewhat below the vein of the donor so that blood will flow into the bag. As the blood is withdrawn from the donor it passes over the anticoagulant 34, dissolving it. The blood in the bag is gently agitated from time to time to insure complete mixing of the contents. The bag, being constructed of flexible material, readily expands as fluid enters the bag, so that no air replacement is necessary.

When the bag is sufficiently full, the cannula in the needle adapter is withdrawn. The other cannula is withdrawn from the donor's vein, retaining the tube full of blood to use as a sample. The bag is then placed in a refrigerator until the blood is to be used for a transfusion or other purposes.

For dispensing the blood, the cannula 31 of the dispensing tube Fig. 2 is inserted into the needle adapter 16. Air is purged from the device by holding the bag in upright position and squeezing the bag or by holding the bag in the down position and allowing the blood to run out. Freedom from air prevents possible contamination of the blood, or air embolism in the patient. A pinchcock may be used to close the tube 42, so that blood will not escape. Then the cannula 30 is inserted into the vein of the receiver. The bag is then hung on a stand, as by the hole 15 on a hook. The pinchcock is partially opened to control the flow of blood, or the bag height determines the rate of flow of the blood. If the transfusion is not fast enough by gravity, the transfusion may be speeded up by squeezing the bag.

In taking blood from a donor or in giving it to a receiver, no air comes into the bag, as it collapses and expands automatically as the blood leaves or enters the bag. The blood, therefore, does not come in contact with air and possible contamination is thereby averted.

If it is desired to give blood plasma to the receiver, the bag is stored with the needle adapter 16 in the uppermost position, as indicated in Fig. 9. The bag is allowed to stand until the cells have settled, leaving the clear plasma on top. The clamp 50 of Fig. 10 is then clamped on the bag immediately above the cells, completely separating the plasma from the cells. The bag may now be

inverted and the transfusion completed as pointed out above, but only the plasma is given, as the cells are held separate from the plasma by the clamp 50. Fig. 9 shows the clamp 50 in place on the bag, separating the cells from the plasma. In lieu of the clamp 50, the bag may be heat sealed along the same line of separation.

A transfusion of the blood cells may also be given by storing the bag with the needle adapter in the down position. After the cells are settled, the clamp is used to separate the plasma and the cells. The cells, having settled in the end of the bag containing the needle adapter, are available for transfusion, leaving the plasma in the bag.

In either instance, after the fraction next the needle adapter has been used, removal of the clamp renders the rest of the contents available for transfusion into the same receiver or some other receiver.

The bag 60 of the modified device of Fig. 4 has an integral anticoagulant chamber 64 and blood filter 66. The bag 60 has two projections with integral needle adapters 16, one leading to the anticoagulant chamber 64, and the other leading to the filter chamber 66. The chamber 64 is formed by heat sealing the walls of the bag 60 together in the L-shaped seal 68. The anticoagulant pellets 34 are placed in the tube before sealing the chamber. The filter chamber is formed by heat sealing the walls of the bag with juxtaposed rectangular seals 70, so that passages are left between the seals. The seals 70 are positioned apart so that fluid may pass freely through the passages between the seals, but the passages are small enough to retain any clots that may have formed.

The double cannula tubing of Fig. 5 may be used with the bag of Fig. 4 for a bleeding tube and a dispensing tube. The device comprises a length of plastic tubing 74 with a Luer needle fitting 76 attached to each end. A standard cannula 78 is attached to the needle fitting. The cannulae 78 are covered to keep them sterile, as by caps 80 and cotton wads at 81.

In using the device of Fig. 4, one of the cannulae 78 of the bleeding tube shown in Fig. 5 is inserted through the needle adapter into the anticoagulant chamber 64. The other end of the bleeding tube is then inserted into the vein of the donor, the bag 60 is held somewhat lower than the donor's vein, to allow the blood to run into the bag. The blood passes over the anticoagulant pellets 34, dissolving them. When the bag is sufficiently full the cannula is withdrawn from the needle adapter of the bag and the other needle is withdrawn from the donor. The bag is then stored in a suitable place until the blood is needed for a transfusion. For a transfusion the bag is hung adjacent the patient and one end of the device as shown in Fig. 5 is inserted into the filter chamber 66. The other end of the tube is inserted into the receiver's vein and the transfusion completed as above.

The anticoagulant pellets in Fig. 4 may be replaced by powdered anticoagulant. If a powder is used, the L-shaped seal 68 is not needed, as the powder will tend to spread throughout the bag. If a liquid anticoagulant is desired, the liquid may be injected through the needle adapter 16 into the bag immediately prior to the transfusion.

The needle adapter 16, shown in detail in Fig. 6, is self-sealing. It comprises a soft elastic cup-shaped member 18, or core, which is completely enclosed by a plastic covering 20. It is important that such a self-sealing adapter be available with the plastic tube, as the resilient plastics now available are not self-sealing. In other words, if a needle is used to puncture a plastic bag or tube, withdrawing the needle will leave a hole.

In the embodiment of Fig. 7 the collapsible bag 88 has two tubular extensions comprising two lengths of tubing projections 90 and 92 adapted to having a standard cannula 30 attached to the end of each tube. The tube 90 extends a short distance into the bag and has a filter 94 attached thereto.

In using the device of Fig. 7, the cannulae are covered with protective covers, such as shown in Fig. 5, and the assembly is sterilized. The device is then a sterile, unitary, complete transfusion apparatus ready for use. The tube 92 is the donor tube, and when the blood has been taken, the tube is sealed, as by tying or a pinch-clamp. The tube 90 is the receiver tube, and the blood passing to the tube must pass through the filter 94.

Storage bags according to the invention may be made from an extruded tube, by sealing the ends of the tube; by folding a sheet of plastic, and sealing the ends and the open side to form the bag; or by dipping a mandril shaped like the bag into a liquid plastic. The dipped-tube type of manufacturing lends itself readily to a very uniform article. The seal 12 is made by compressing the sides of the tube together and heat-sealing. Likewise, the seals 68 and 70 are made by pressing the tube walls together and heat-sealing.

The material used for making the bag and the tubing is preferably transparent or translucent, and must be flexible to allow the bag to inflate and collapse. Commercial synthetic thermoplastic resins such as cellulose resins, polystyrene, vinyl polymers and like plastics are suitable for use in making the transfusion apparatus. It is preferable not to use rubber as rubber tends to coagulate blood quicker than does a synthetic plastic, however, it may be used if the coagulation time is not important.

This application is a divisional application of my co-pending application, Serial No. 103,202, filed July 6, 1949.

Others may readily adapt the invention for use under various conditions of service by employing one or more of the novel features disclosed or equivalents thereof. As at present advised with respect to the apparent scope of my invention I desire to claim the following subject matter.

1. In a transfusion device, the combination which comprises: an imperforate, flexible, collapsible bag; a plurality of projections integral with said bag and in open communication therewith; and filter means in the nature of a series of closely spaced small passages defining a relatively small chamber communicating with one of said projections.

2. In a transfusion device, the combination which comprises: an imperforate, flexible, collapsible container having a plurality of projections communicating with said container; certain of said projections being provided with connecting means in the nature of an integral self-sealing needle adapter; and filter means interposed between said container and one of said projections.

3. In a transfusion device, the combination which comprises: an imperforate, flexible, collapsible bag; a plurality of tubular extensions integral with said bag and communicating with the interior thereof; means adjacent one of said tubes defining a relatively small chamber within the confines of said bag and separated therefrom by a filtering barrier; and means adjacent another of said tubes defining a second relatively small chamber communicating said tube and with said bag and adapted to hold a charge of solid anticoagulant.

4. In a transfusion device, the combination which comprises: an imperforate, flexible, collapsible bag; a tube communicating with the interior of said bag; and fluid-penetrable means connecting portions of the walls of said bag and separating the interior thereof into a pair of chambers; said means constituting a barrier to the passage of non-fluid material from one of said chambers to the other thereof.

5. In a transfusion device, the combination which comprises: an imperforate, flexible, collapsible bag; a projection integral with said bag; said projection having a soft, elastic core completely enclosed by the material of a wall of said projection; and fluid-penetrable means connecting portions of the walls of said bag and separating the interior thereof into a pair of chambers; said means

comprising a plurality of separate areas of interattachment between said wall portions; said areas being spaced from each other a distance which will permit free passage of fluid therebetween and which is small enough to prevent the passage of non-fluid material therebetween. 5

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