June 4, 1957 P. A. STEVENS 2,794,435

NEEDLE TERMINAL ASSEMBLY

Filed July 31, 1952

FIG. 1

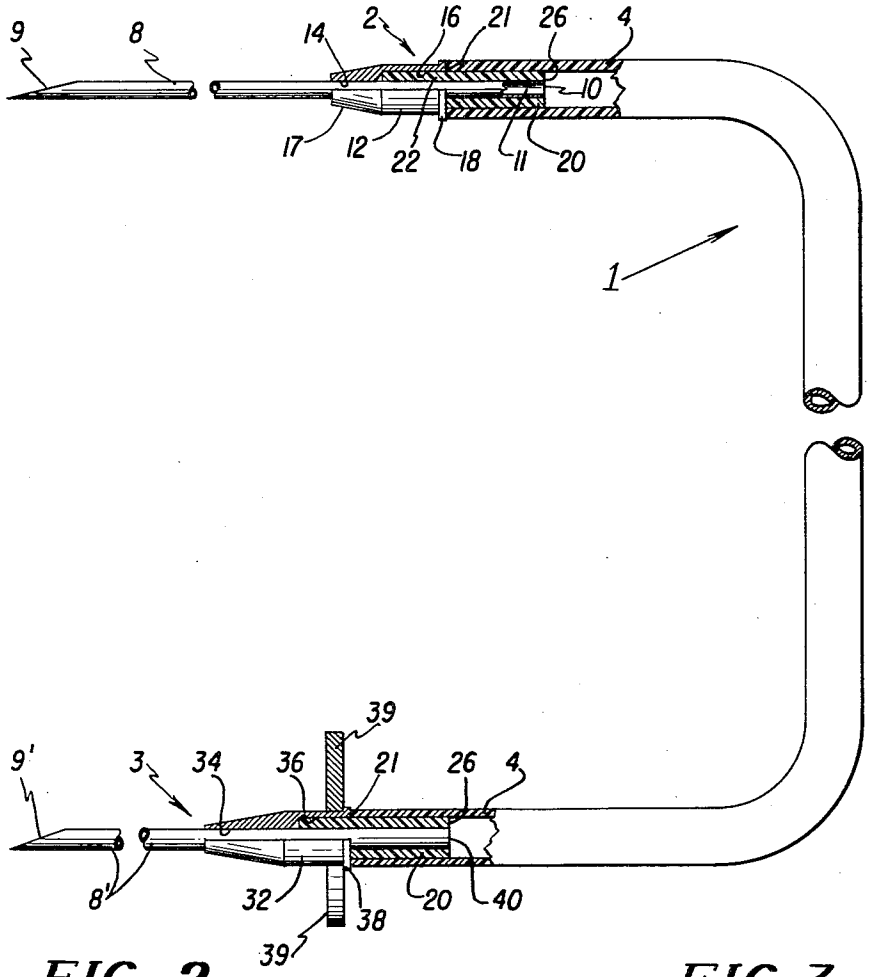


FIG. 2

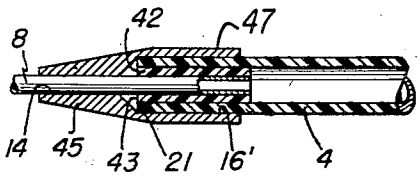
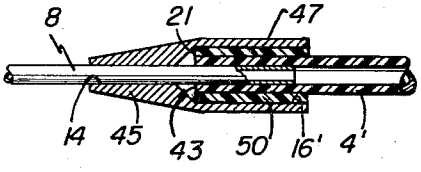


FIG. 3



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NEEDLE TERMINAL ASSEMBLY

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This invention relates to a flow tube and needle assembly, particularly to the assembly of the blood flow tube with the needles at the two ends thereof in a blood donor set, although the invention is not specifically limited to blood donor sets.

A blood donor set includes amongst other things a hypodermic needle for receiving the donor's blood, which needle is connected by a flexible tube to a piercing needle that delivers the blood into a sterile container. It is one of the objects of the present invention to provide such a connection between the tube and the needles that the end of the needle that is connected to the tube cannot injure the flexible tube. This is accomplished, in the preferred embodiment of the present invention, by providing a spacer between the very end of the sharp needle and the blood flow tube, so that the sharp end of the needle cannot under any circumstances pierce the tube. The spacer makes a sealing fit around the needle and also makes a sealing fit within the tube. This permits the use of a tube of a substantially larger diameter than the diameter of the needle. The large diameter blood flow tube may be depressed slightly and then released to draw blood for aspiration.

While the present invention is concerned, in its most specific aspects, with the connection to piercing needles of the type used in a blood donor set, in its broader aspects the invention is applicable to the means for establishing connections with a piercing needle, whether that is part of a blood donor set or any other type of equipment, more particularly, equipment used in the medical arts. By way of example, in some instances there is provided a flexible tube which is to be connected to a needle and which tube is required to be of a small diameter. In such case, also, the principles of the present invention are applicable for preventing piercing or injury of the flexible tube by the cannula. This may be accomplished by providing the spacer tube on the outside of the flexible flow tube rather than on the inside thereof, so that the spacer tube is between the flexible tube and the hub of the hypodermic of piercing needle rather than between the flexible tube and the cannula of the needle. It is a still further object of the present invention to provide means for facilitating securing of a flexible flow tube within the hub of a needle, even though the flexible flow tube may be comparatively thin.

The attainment of the above and further objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawing forming a part thereof.

In the drawing:

Figure 1 is a view, in partial section, of a needle assembly of a blood donor set;

Figure 2 is a longitudinal sectional view illustrating a modification of the structure of Figure 1; and

Figure 3 is a longitudinal sectional view illustrating still another modification.

In the drawing like reference numerals designate like parts throughout.

At 1 there is shown a portion of a blood donor set that includes a donor needle assembly 2, a rubber-piercing needle assembly 3, and a flexible tube 4 of "Vinylite" or other suitable material, preferably transparent or semi-transparent, connecting the two needles for the flow of fluid, in this instance blood, from one needle and out through the other. The donor needle assembly 2 includes a cannula 8 having a penetrating point 9 at one end thereof, the opposite end 10 being squared, namely at right angles to the central longitudinal axis of the lumen of the cannula. The cannula is of stainless steel tubing, in this instance having an outside diameter of .058 inch and having a longitudinal bore or lumen 11 from end to end therethrough and of an internal diameter of .042 inch. The above figures are merely illustrative of one construction. The cannula extends through a hub 12 that is swaged thereon. To that effect the hub has a needle-receiving bore 14 and a connecting counterbore 16. A conical portion 17 of the hub may be swaged on the needle. The hub may, optionally, have a peripheral flange 18 at one end thereof, which flange acts as a stop for the tube 4.

The outer "Vinylite" tube 4 has an auxiliary inner "Vinylite" tube 20 inserted thereinto and projected beyond the end 21 of the tube 4, as indicated at 22. In the particular construction here illustrated the outer tube had an internal diameter of .140 inch whereas the inner tube had an outer diameter of .150 inch, so that the outer tube is tensioned by the inner tube and in turn compresses the inner tube. The two "Vinylite" tubes are cemented together in such a manner that the cementing assures an air-tight and liquidtight seal between them. A "Vinylite" solvent is one suitable cementitious material. In the construction herein illustrated the inner tube 20 was of an internal diameter of .050 inch and fitted over a cannula having an external diameter of .058 inch, so that the inner tube was tensioned on and made a snug sealing fit around the cannula. The portion of the inner tube 20 that extends outwardly of the end 21 of the outer tube is inserted into the bore 16 of the hub until the end 21 of the outer tube abuts against the flange 18. This limits the extent to which the cannula may be inserted into the inner tube. The length of the portion of the cannula projecting beyond the flange 18 is exactly equal to the distance between the end 21 of the outer tube and the end 26 of the inner tube, so that when the end of the outer tube abuts against the flange 18 the end 26 of the inner tube is exactly flush with the end 10 of the cannula.

The construction of the rubber piercing needle 3 is substantially the same as that of the donor needle 2. The rubber piercing needle includes a stainless steel cannula 8' having a rubber piercing end 9' on which is swaged a hub 32, said needle extending through a bore 34 in the hub which bore 34 opens into a larger bore 36 that terminates in a peripheral flange 38. A washer 39 is secured to the hub 32 adjacent to the flange 38 to facilitate forcing of the rubber piercing point 9' of the cannula 8' into and through the plug of rubber or the like which closes a sterilized blood-receiving bottle, preferably evacuated, as is well known in the art. The tube 4 has at the rubber piercing needle end thereof an inner tube 20 of the same size and construction as was previously described secured therein in the same manner as was previously described. The end 40 of the cannula 8' terminates flush with the inner end of the tube 20. The end 26 of the tube 20 at the rubber piercing end of the blood donor set is located the required distance from the adjacent end 21 of the outer tube 4 so that when the piercing needle is assembled with the tube 4 by inserting the cannula into the tube 20 the end 40 of the cannula will reach the end 26 of the tube 20 when the adjacent end of the tube 4 abuts against the flange 38. By such

abutment one is apprised of the fact that the end **40** of the needle is flush with the inner end **26** of the inner tube **20**. In this construction, as in the donor end of the tube **4**, the outside diameter of the cannula (**8'**) is greater than the inside diameter of the tube **20**. In one construction the cannula, of an outside diameter of .072 inch, was inserted into a tube **20** having an inside diameter of .050 inch, thus stretching the tube **20** and thereby producing a sealing liquid-tight and air-tight fit around the needle for substantially the full length of the tube **20**.

In the construction above described, any flexing of the tube **4** at either end thereof results in compression of part of the wall of the tube **4** at the end **26** of the inner tube but such flexure cannot possibly bring the outer tube **4** into physical contact with the inserted end of the cannula. As a result, there is no danger that the inner end of the cannula can injure the outer tube.

In view of the fact that the plastic tube is inserted directly on the cannula there is assurance of continuous flow directly through the cannula and it is not necessary to solder the hub onto the cannula or to take other precautions to make sure that the hub in either case makes an air-tight sealing fit around the periphery of the cannula.

In the construction above described the liquid that flows through the needles is never in contact with the hubs. As a result, the finish on the hubs does not have to be made with the care that would otherwise be required.

In the arrangement above described there is used a tube **4** of an internal diameter large in comparison with the external diameter of the cannula without the disadvantage of requiring a liquid-tight, air-tight seal between the tube **4** and the hub. The fact that the tube **4** is of large diameter permits aspiration. After the donor needle has been inserted in position in the body of the donor the technician can easily aspirate to determine if the needle is piercing the proper place. This result can be achieved by manually pinching the tube at two adjacent places and then releasing the pinching action at the place closest to the donor, so that that release will cause the drawing of blood. By making the tube **4** transparent the presence of blood can be noted. The material of the tube **4** is sufficiently elastic so that when the tube **4** is pinched together to stop flow therethrough the elastic limit of the material is not exceeded, so that upon release of the pinching action the material will spring back to its original shape under its natural resiliency.

It is apparent from the above description that the end **10** of the cannula **8** cannot possibly come into contact with the tube **4** regardless of the amount of flexing or bending of the tube at the end thereof. As a result, it is possible to make the tube **4** of very thin material since the danger of piercing or fracturing of the tube by the cannula has been eliminated. The tube **4** can be made of as large a diameter as is desired, it being recognized that a large diameter is advantageous in many respects.

The length of the cannula within the tube **20** is sufficient to form an air-tight seal between the tube and the outside of the cannula. This, together with the fact that there is an air-tight seal between the inner tube **20** and the outer tube **4**, assures that no air can be drawn into the tube **4** from the atmosphere immediately surrounding the hub **12**. For this reason there is no necessity for soldering the hub to the cannula as would otherwise be necessary where it is desired to secure a leak-tight connection between the hub and the cannula. The elimination of soldering also reduces the danger of corrosion.

In Figure 2 there is shown a modified construction of the donor needle assembly or of the piercing needle assembly. In this case, as before, the blood flow tube is indicated at **4**, being made of plastic (or rubber) as previously described. In this construction the inner "Vinylite" tube is indicated at **42**, that tube corresponding to the tube **20** of Figure 1 and differing therefrom only

in that it is of shorter length so that the end **43** thereof terminates flush with the end **21** of the tube **4**. The cannula **8** has a hub **45** secured thereto in any desired manner, the cannula extending through the bore **14** thereof and through the counterbore **16'**. This counterbore differs from the counterbore **16** essentially only in that it is of larger diameter, a diameter sufficient to receive the end of the tube **4**, which tube makes a snug sliding fit therein. The cylindrical wall **47** of the hub may be pinched radially inwardly to assure locking of the tube **4** within the hub. In this construction the tube **42** may be longer than the bore **16'**, or of a length equal to the length of the bore **16'**, or shorter than the bore **16'**. In this construction, as in the construction of Figure 1, there is the advantage of using a tube **4** of a diameter appreciably larger than the external diameter of the cannula. In this structure the blood or other fluid flowing through the tube **4** cannot possibly come in contact with the hub and the thin flexible tube **4** is safe against being torn or injured by the end of the stainless steel cannula.

In Figure 3 there is shown a modified construction that is somewhat similar to the construction of Figure 2 but differs therefrom in that here the tube **50**, that corresponds to the tube **42** of Figure 2, is on the outside of the blood flow tube **4'** rather than on the inside thereof. In some types of medical apparatus it is desirable to use a small diameter flow tube **4'** through which blood or other fluid flows. When this is the case the tube **50**, which is sealed on the outside of the tube **4'** to form a liquid-tight, air-tight seal, provides the necessary thickness at the bore **16'** so that the wall **47** of the hub may be pinched tight onto the inserted tube end and permit the use of a thin walled tube **4'** where otherwise a larger thickness tube might be called for.

The assembled unit of Figures 1, 2, or 3 must, of course, be sterilized. This may be accomplished in any desired manner, heat sterilization being one approved method. When a "Vinylite" tube which is under tension is subjected to the heat of sterilization it may stretch sufficiently to overcome the tension. The tubes **26** of Figure 1 being cement sealed within the tube **4** of Figure 1 maintain an air-tight seal between them, regardless of the tension of the tube **4**. Likewise, for that same reason, the two "Vinylite" tubes **4** and **42** of Figure 2 and **4'** and **50** of Figure 3 may be cement sealed together to form air-tight seals. In order to maintain the air-tight seal between the outer periphery of the cannula **8** and the plastic tube that fits thereover in Figures 1, 2, and 3, the cylindrical portions of the hubs **12**, **32** and **47** may be crimped radially towards the inserted tube to provide a ring of pressure to maintain an air-tight sealing fit between the cannula and the end of the plastic tube into which it has been inserted.

In compliance with the requirements of the patent statutes I have here shown and described a few preferred embodiments of my invention. It is, however, to be understood that the invention is not limited to the precise constructions here shown, the same being merely illustrative of the principles of the invention. What I consider new and desire to secure by Letters Patent is:

1. In a medical apparatus including a flexible tube terminating in a needle having a cannula with a lumen therethrough, a part of the cannula being telescoped into the tube, means for inhibiting injury of the tube by the end of the cannula therein, said means comprising an auxiliary tube of flexible material within the end of the first tube and surrounding the end of the cannula that is within the first tube and terminating within the first tube flush with the surrounded end of the cannula, and a hub secured to the cannula and having a bore into which one of said tubes extends and makes a snug fit.

2. In a medical apparatus including a flexible tube terminating in a needle having a cannula with a lumen therethrough, a part of the cannula being telescoped into the tube, means for inhibiting injury of the tube by the end

of the cannula therein, said means comprising an auxiliary tube of flexible material within the end of the first tube and surrounding the end of the cannula that is within the first tube and terminating within the first tube flush with the surrounded end of the cannula, the auxiliary tube making an air-tight fit around the cannula and an air-tight fit within the first tube, and a hub secured to the cannula, said hub being in telescoping relationship with at least one of the tubes and being sealed from the path of flow through the lumen by the air-tight fit hereinabove referred to.

3. In a medical apparatus including a flexible tube terminating in a needle having a cannula with a lumen therethrough, a part of the cannula being telescoped into the tube, means for inhibiting injury of the tube by the end of the cannula therein, said means comprising an auxiliary tube of flexible material within the end of the first tube and surrounding the end of the cannula that is within the first tube and terminating within the first tube flush with the surrounded end of the cannula, the auxiliary tube making an air-tight fit around the cannula and an air-tight fit within the first tube and extending outwardly of the first tube, and a hub for the cannula, said hub having a bore into which the auxiliary tube makes a snug fit, and the end of the first tube abutting against the hub.

4. In a medical apparatus including a flexible tube terminating in a needle having a cannula with a lumen therethrough, a part of the cannula being telescoped into the tube, an auxiliary tube of flexible material within the end of the first tube and surrounding the end of the cannula that is within the first tube, the auxiliary tube making an air-tight fit around the cannula and an air-tight fit within the first tube and extending outwardly of the first tube, and a hub for the cannula, said hub having a bore into which the auxiliary tube makes a snug fit.

5. In a medical apparatus including a flexible tube terminating in a needle having a cannula with a lumen therethrough, a part of the cannula being telescoped into the tube, an auxiliary tube of flexible material within the end of the first tube and surrounding the end of the cannula that is within the first tube, the auxiliary tube making an air-tight fit around the cannula and an air-tight fit within the first tube, and a hub for the cannula, said hub having a bore into which one of the tubes makes a snug fit.

6. In a medical apparatus including a flexible tube terminating in a needle having a cannula with a lumen therethrough, a part of the cannula being telescoped into the tube, an auxiliary tube of flexible material within the end of the first tube and surrounding the end of the cannula that is within the first tube, the auxiliary tube making an air-tight fit around the cannula and an air-tight fit within the first tube and extending outwardly of the first tube, and a hub for the cannula, said hub having a bore into which the auxiliary tube makes a snug fit, said first tube being transparent and sufficiently resilient to permit manual pinching of the same to stop flow therethrough without exceeding the elastic limit of the material thereof.

7. In combination, a cannula, a hub secured to the cannula, a first flexible tube surrounding the cannula and terminating flush with one end thereof and extending into the hub, and a second flexible tube surrounding the first tube and extending from an intermediate portion of the first tube to and beyond said end of the cannula.

8. In combination, a cannula, a hub secured to the cannula intermediate its ends, a first flexible tube surrounding the cannula and terminating flush with one end of the cannula, and a second flexible tube surrounding the first tube and extending from the hub to and beyond the end of the cannula, the first tube making a sealing fit with the cannula and with the second tube.

9. In combination, a cannula having a pointed penetrating end and squared at its opposite end, a hub secured to the cannula intermediate its ends, a first flexible tube surrounding the cannula and terminating flush with the squared end and extending into the hub, and a second flexible tube surrounding the first tube and extending from the hub to and beyond the squared end of the cannula.

10. In a blood donor set of the type that includes a donor needle assembly for receiving blood from a donor and a piercing needle assembly for delivering the blood to an evacuated receptacle and a flexible tube connecting the two assemblies, at least one of the assemblies including a cannula; means for making an air-tight seal between the cannula and the tube and preventing injury of the tube by the end of the cannula upon flexing of the tube, said means comprising a second tube extending axially into the first tube and making an air-tight fit therewith, said cannula extending axially into the second tube and terminating therein flush with that end thereof which is within the first tube and said second tube being tensioned around the cannula and making an air-tight sealing fit therewith, and a hub on the cannula intermediate the ends thereof, said hub having a bore into which the second tube extends, the cannula projecting outwardly of the hub an amount equal to the amount that the second tube extends into the first tube, the end of the first tube abutting against the hub.

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