United States Patent

Baldwin

[15] **3,659,587**

[45] **May 2, 1972**

[54] VALVED CONNECTOR ARRANGEMENT

[72] Inventor: **Brian E. Baldwin,** Wilmette, Ill.

[73] Assignee: **Affiliated Hospital Products, Inc.,** St. Louis, Mo.

[22] Filed: **June 30, 1970**

[21] Appl. No.: **51,047**

[52] **U.S. Cl.**.....**128/2 F,** 128/218 NV, 128/DIG. 5

[51] **Int. Cl.**.....**A61m 05/00,** A61b 05/10

[58] **Field of Search**.....128/2 R, 2 F, 218 NV, 214.4, 128/221, DIG. 5

[56] **References Cited**

UNITED STATES PATENTS

1,180,665	4/1916	McElroy	128/218 NV UX
3,494,352	2/1970	Russo et al.	128/2 R
3,585,996	6/1971	Reynolds et al.	128/214.4

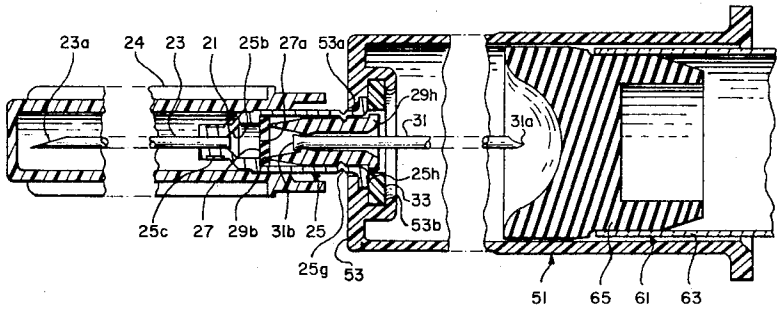
Primary Examiner—Hugh R. Chamblee

Attorney—Reginald F. Pippin, Jr.

[57] **ABSTRACT**

A valved connector arrangement having a pair of tubes and a slitted transverse elastic disk partition normally separating and disconnecting the interior of the two tubes, one of the two tubes being slidable toward and away from the slitted disk partition to effect mechanical opening and permit self-reclosing of the slitted partition. In the embodiment, the other tube is fixed, and the two tubes are pointed at their outer ends to enable their use in a multiple sample blood collecting needle arrangement, including a removable vacuum collecting container with a rubber stopper engageable by one of the pointed tubes.

13 Claims, 19 Drawing Figures



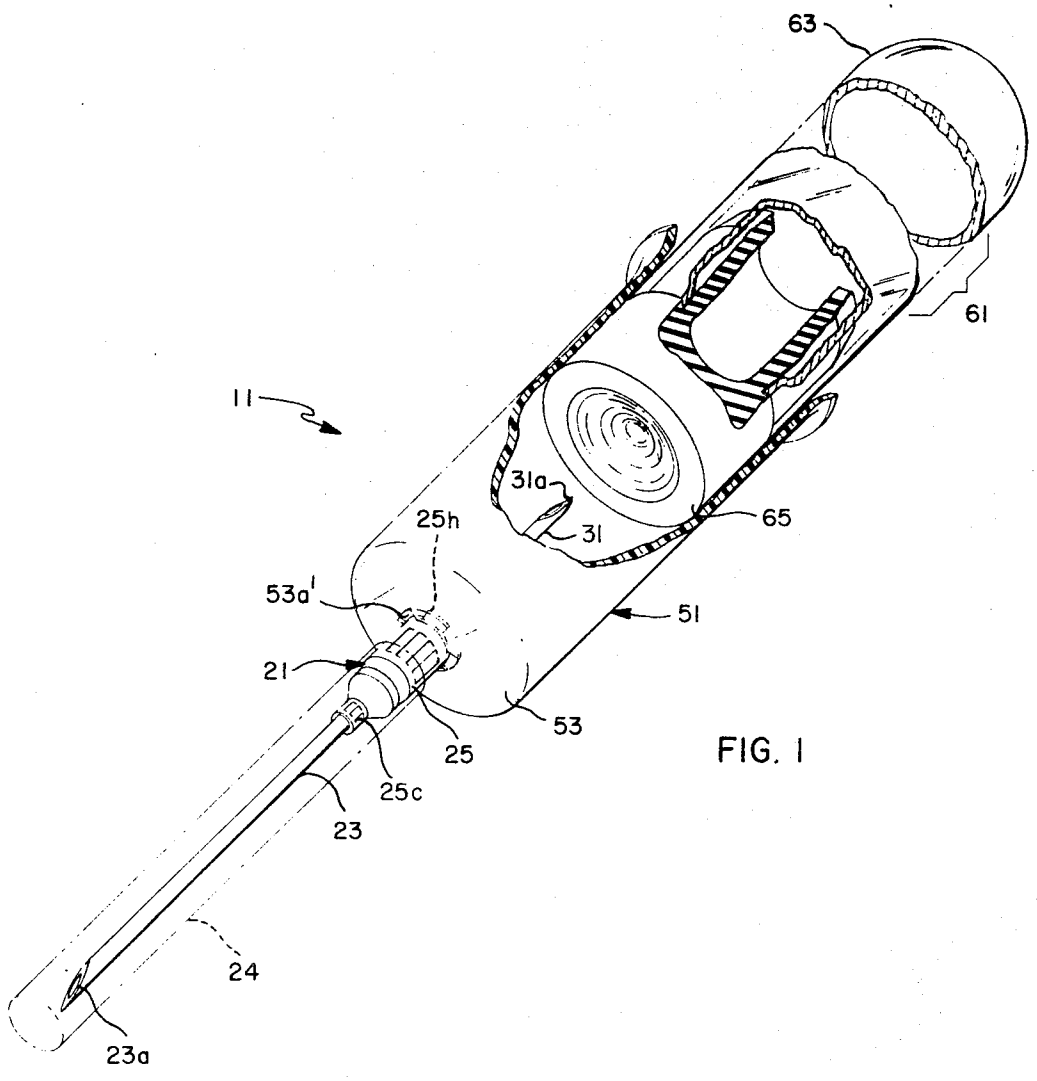


FIG. 1

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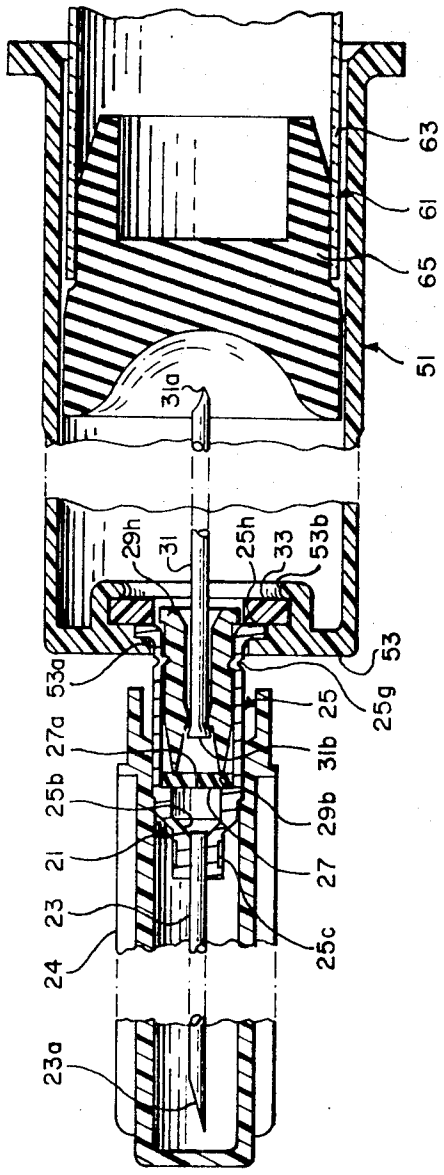

FIG. 2

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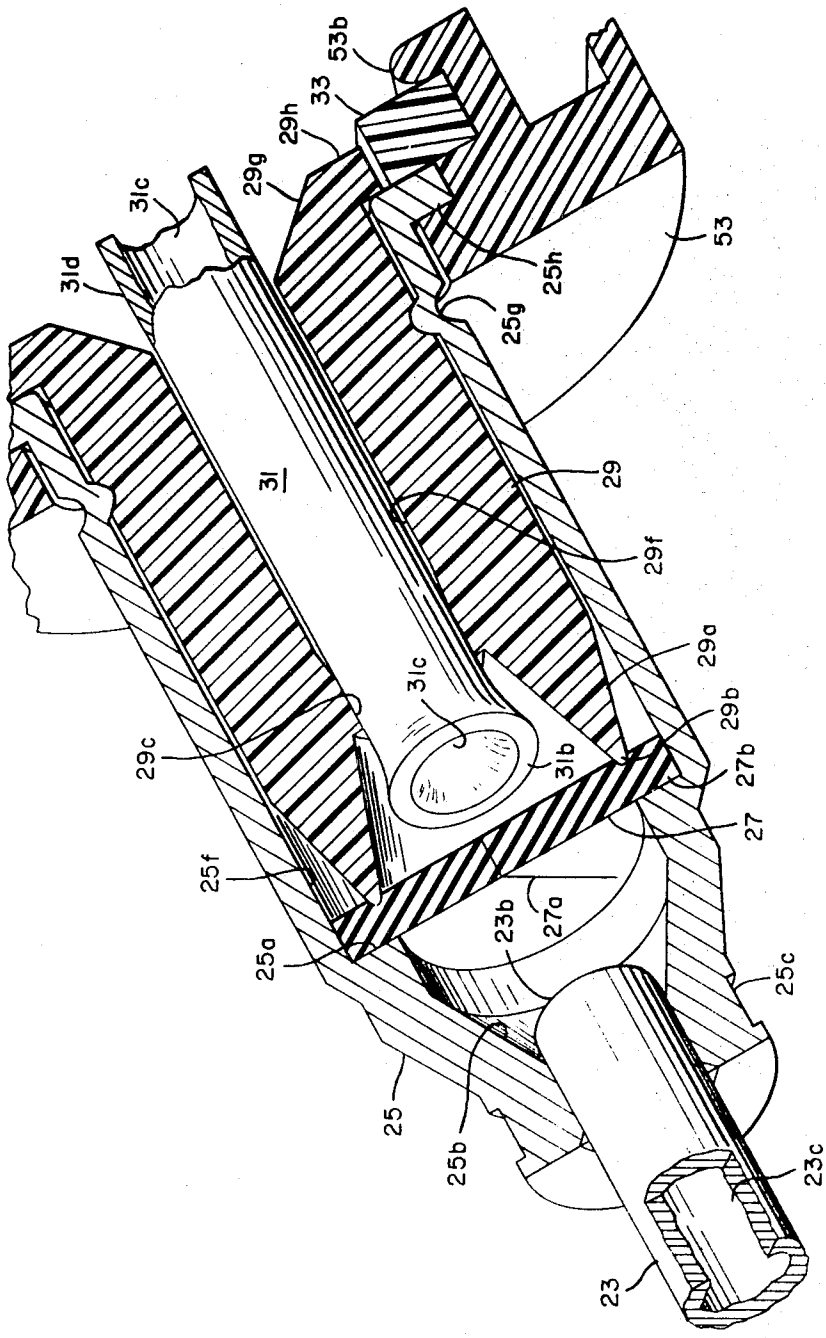

FIG. 3

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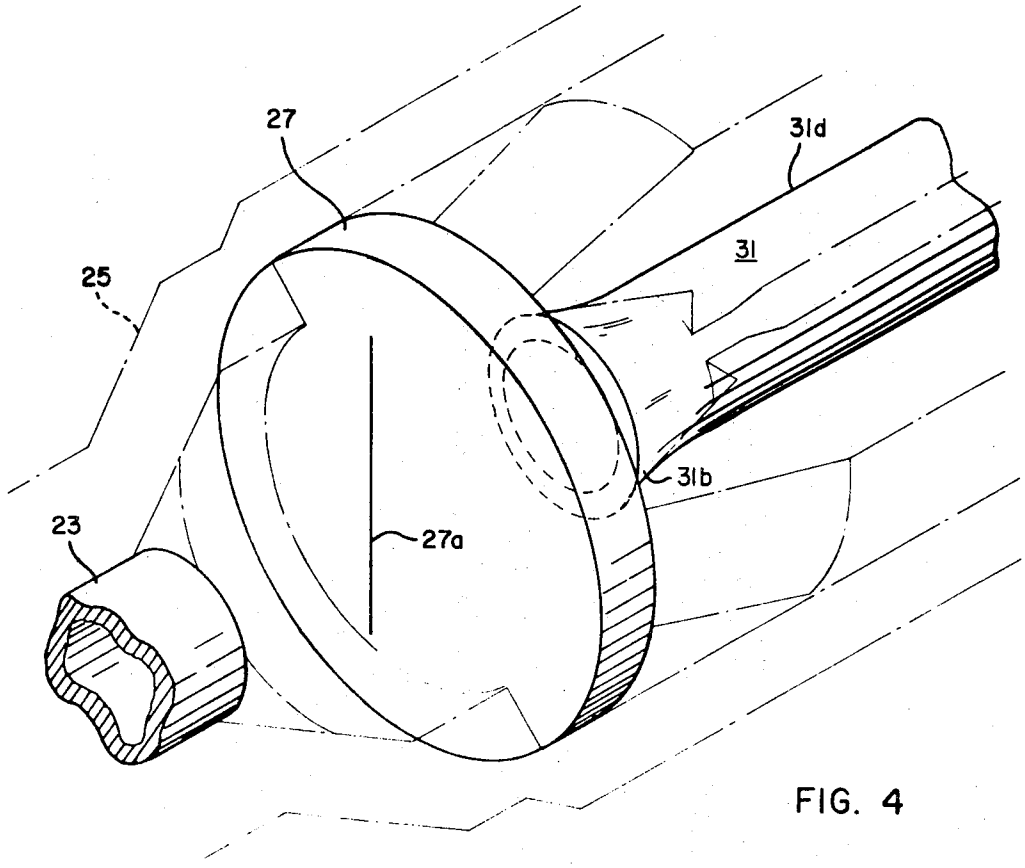

FIG. 4

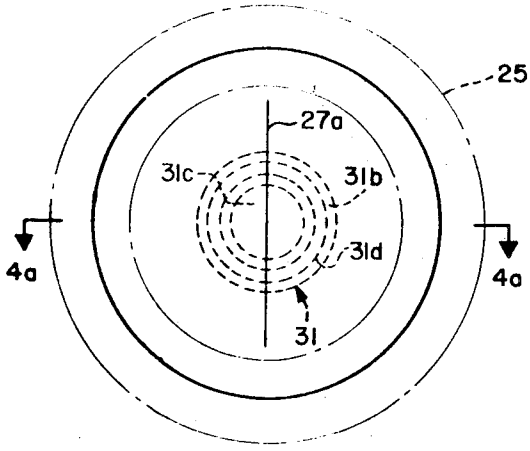

FIG. 4b

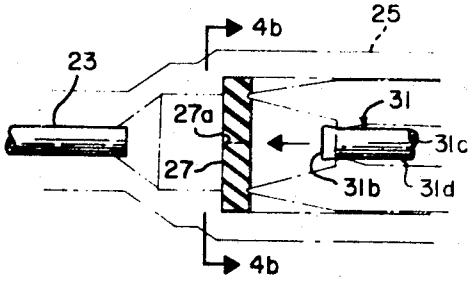

FIG. 4a

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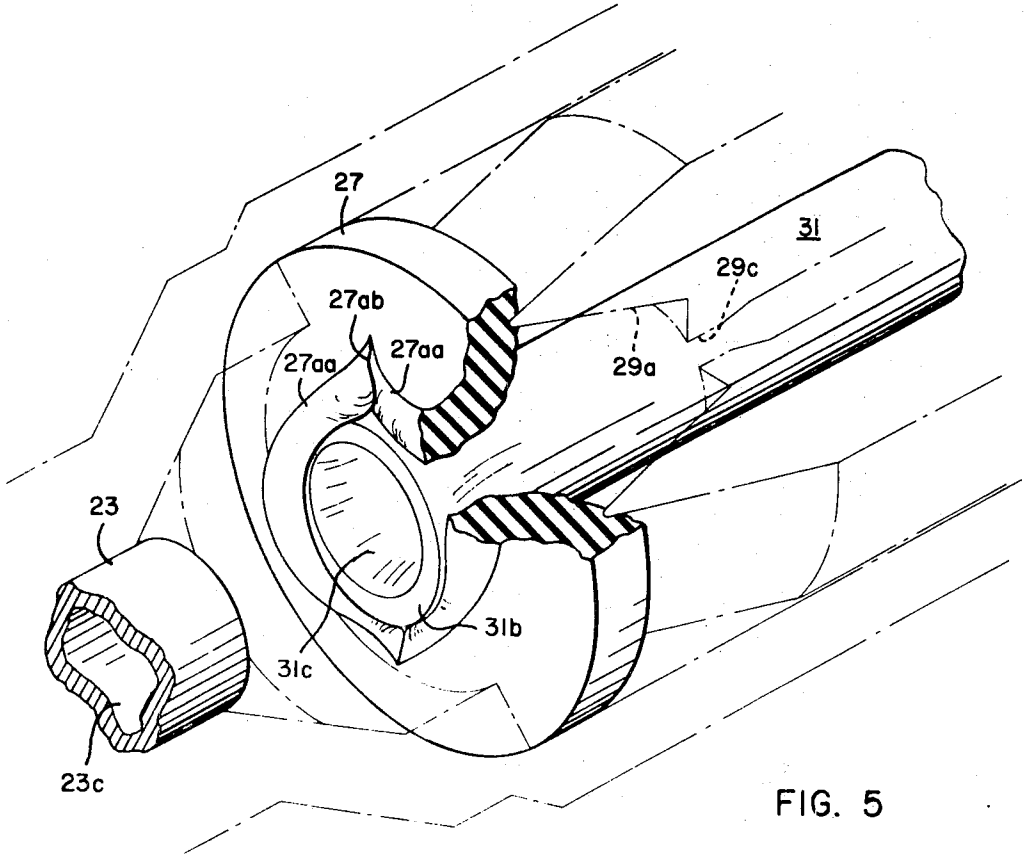

FIG. 5

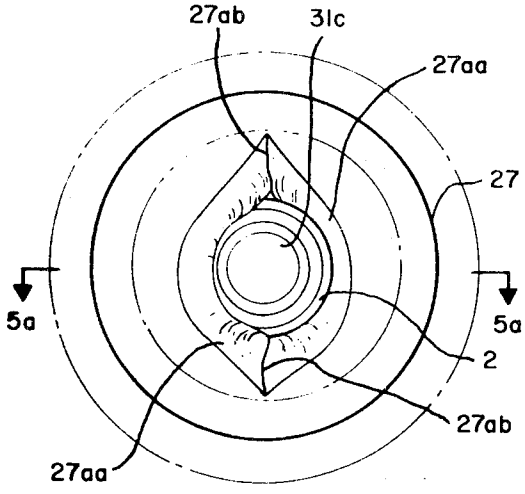

FIG. 5b

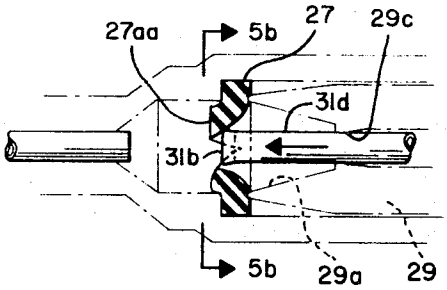

FIG. 5a

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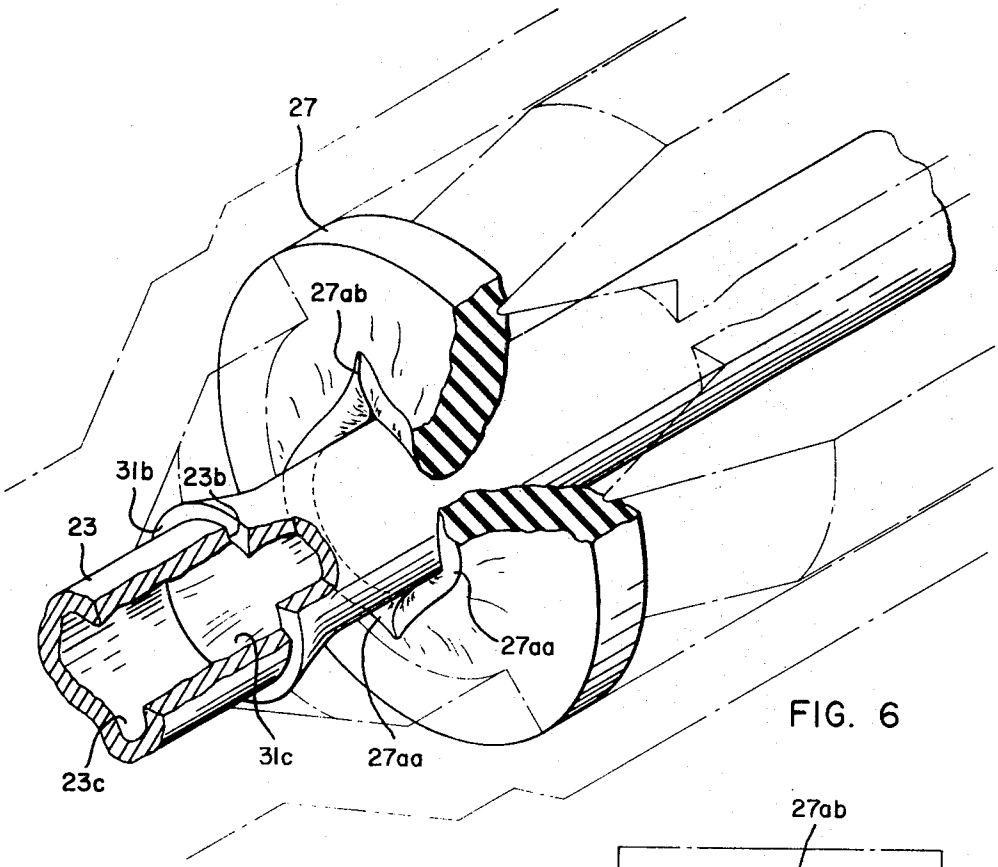

FIG. 6

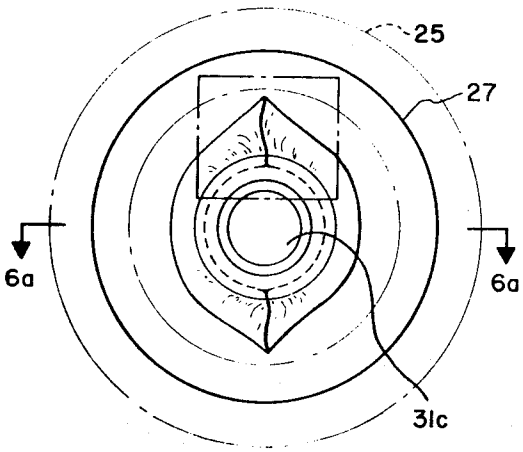

FIG. 6b

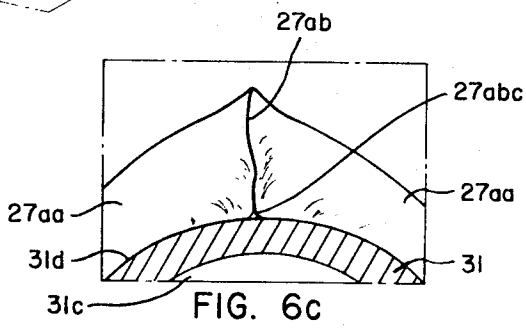

FIG. 6c

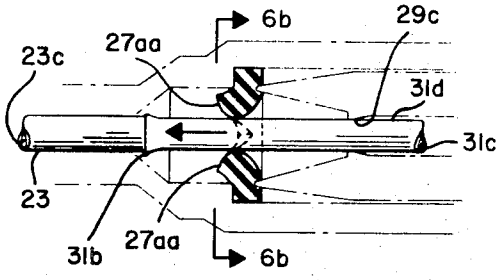

FIG. 6a

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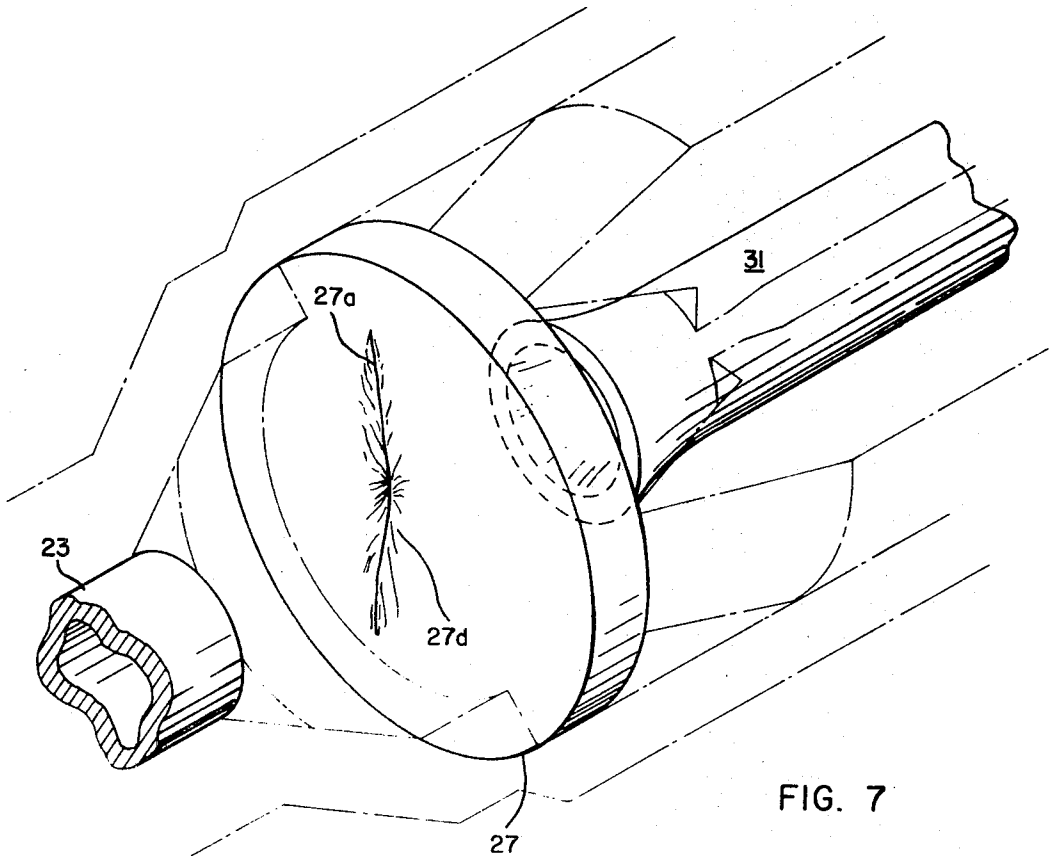

FIG. 7

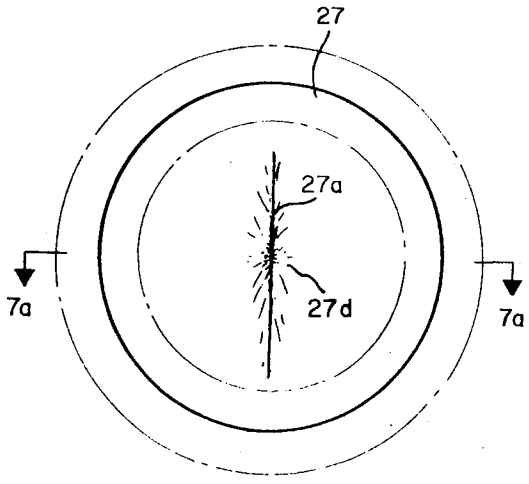

FIG. 7b

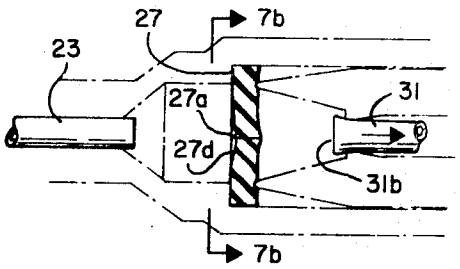

FIG. 7a

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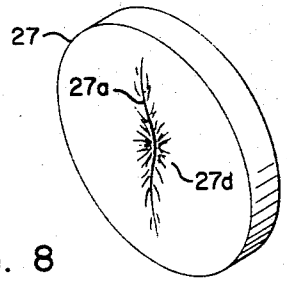

FIG. 8

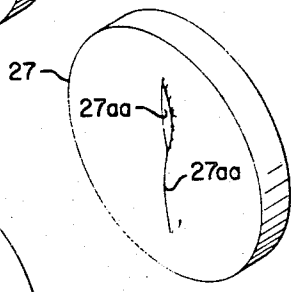

FIG. 10

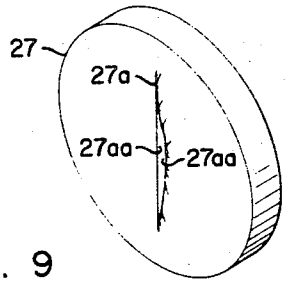

FIG. 9

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VALVED CONNECTOR ARRANGEMENT

This invention relates to a valved connector arrangement, and more particularly to a valved needle connector arrangement for use in enabling the collection of multiple samples of blood.

For various reasons, including the automation of blood chemistry analysis and the lower cost of such analysis, it is now often desirable to collect multiple blood samples from a single venipuncture. Under such a system of multiple sample blood collection, at times as many as eight samples being taken during one sequence, a suitable venipuncture needle is inserted into a vein, and a plurality of suitable containers, commonly being evacuated glass vials with rubber stoppers, are suitably sequentially separately connected to the venipuncture needle assembly. In effecting such sample collection with succeeding containers, it is desirable that the needle assembly be provided with means for preventing the flow of blood from the vein in the interim prior to and between individual collections. In the prior art, various valved arrangements have been proposed for effecting this operation, although none of such arrangements, to my knowledge, have been entirely satisfactory.

For instance, in one commercial arrangement, a venipuncture needle is provided, the butt end of which is pointed and sealed off, and a side opening is formed in the butt end section which is normally closed off by a close fitting elastic tube which is pushed back and accordian-folded along the needle or cannula as the pointed butt end is inserted into the rubber stopper of a vacuum container for collection of blood. Upon separation of the needle from the rubber stopper, the elasticity of the tube tends to return it over the side opening to thereby cut off the blood flow. However, as the blood exits at right angles to the axis of the tube through the side opening, the stream of blood strikes the side wall of the vacuum container at a high velocity, creating what is known as hemolysis, or the mechanical breakdown of the blood cells. This is not desirable, as it interferes with the desired analysis. In addition, as the elastic sleeve may lose its elasticity over a period of storage time, the desired quick return of the tube may not be maintained. Further, the desired rapid return of the elastic tube from its accordion-folded position to its normal closure position is normally effected by the application of substantial amounts of lubricants, such as silicone oil, which can be detrimental to the chemical analysis of the blood sample. It is also extremely difficult and costly to produce tubing with the degree of required tolerance to effect both full blood flow cutoff and fast return of the tube sleeve. Further, the return of the rubber or other elastic sleeve past the side opening in the butt end of the tube produces a sizeable droplet by the scooping action of the butt end of the sleeve in passing the side opening in the cannula. The accumulation of these droplets when four, five, or six samples are taken is normally sufficient to soil the holder, thereby essentially defeating the purpose of the unit, which is to prevent this soil contamination and the resulting hazard to the user.

A further arrangement has included a double-ended needle arrangement, including a single tube or cannula which is pointed at each end, the butt end of the cannula having normally disposed thereover an elastic loose fitting sleeve which is closed at its outer end and which may be folded down over the butt end of the cannula, whereupon the butt end point punctures the elastic cover tube wall and effects communication between the opposite pointed end of the needle or cannula and a container or other device or body which may be penetrated by the butt end. While this device, with its straight-through blood flow action, effectively removes the hemolysis problem and some of the other problems associated with the first described device, the valving arrangement is not altogether satisfactory, as such must normally be manually controlled by the operator to assure reclosure of the butt end of the needle by the elastic cover tube upon removal of the sample container therefrom.

It has also been proposed in a recent U.S. Pat. No. 3,494,352 to Russo, et al., to provide a valved needle arrangement with one cannula rigidly secured for venipuncture, and a second cannula being double-ended (i.e., pointed at both ends) and slidable to pierce a puncturable self-sealing partition normally disposed between the two cannula for the purpose of effecting fluid disconnection between the two cannula. However, the double-ended slidable cannula is purposely made loosely fitting in this arrangement, and enables the passage of air from the ambient atmosphere into any chamber containing the inner pointed end of the slidable cannula, thereby enabling air passage into the blood collecting container while such is connected thereto. In addition, by virtue of this loose, oversized fitting of the slidable cannula, this cannula may easily be rotated during container attachment or removal, or in the interim periods. With such rotational translation of the position of the double-ended cannula, which has a bevel-pointed inner end, may contact and pierce the rubber partition at various rotational positions, thereby effectively cutting out a plug from the rubber partition. As a result, after two, three, or more penetrations of the rubber partition by the double-pointed needle, the partition may no longer be able to restrain fluid passage therethrough upon removal of the double-ended slidable needle therefrom. In fact, in some embodiments constructed pursuant to the teachings of this patent, it has been found that only one or two punctures of the partition by the double-ended cannula have resulted in sufficient puncture of the disk partition to prevent complete reclosure and resealing thereof upon removal of the double ended cannula whereupon fluid flow is no longer cut off upon removal of the double-ended cannula from the partition. The device is also difficult to use in that the apparently necessarily thick partition and the associated surrounding structure, in the only disclosed construction, render the partition quite difficult to puncture with the slidable cannula.

It is a major feature of the present invention to provide an improved valved connector arrangement which is particularly well adapted to enabling the taking of multiple samples of blood or other desired fluid, and which provides for full cutoff of blood flow between samples.

Still a further feature of the invention is to provide an improved valve arrangement which enables two normally disconnected tubes to be selectively interconnected in fluid flow relation, or to be disconnected from one another in fluid flow relation, which valving arrangement does not require the employment of a piercing point for the effecting of fluid connection.

Still a further object and feature of the invention is the provision of a multiple sample blood collecting arrangement incorporating two relatively movable needles or cannulas which are initially and normally in fluid disconnection from one another, the adjacent ends of each of the two cannulas being normally in connection with respective ones of two individual chambers which are likewise in fluid disconnection from one another, the fluid disconnection being effected by a slitted partition unit having pre-formed lips normally resiliently held in contiguous relation with one another, and the sliding movement of one of the cannulas effecting opening of the lips of the partition unit to connect the two cannulas and the two chambers, both chambers being sealed from the atmosphere except through the respective central bores of the respective cannulas, thereby preventing undesired air contamination or air bubbles in the fluid sample as by air passage about the periphery of the slidable cannula.

Still other objects, features and attendant advantages will become apparent to one skilled in the art from a reading of the following detailed description of a preferred embodiment constructed in accordance with the invention, taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective view of a multiple sample blood collecting arrangement incorporating the present invention, preparatory to use.

FIG. 2 is a longitudinal section view of the major portion of the embodiment of FIG. 1.

FIG. 3 is a fragmentary longitudinal sectional view in perspective and enlarged to better illustrate the operating valve elements.

FIG. 4 is a diagrammatic view, with certain parts in phantom and some parts omitted for clarity, illustrating the major operating valve portions of the embodiment of FIGS. 1–3, the embodiment being shown in the normal fluid cutoff position.

FIG. 4*a* is a schematic longitudinal sectional view of the enlargement and parts as shown in FIG. 4, being taken on the line 4*a*–4*a* of FIG. 4*b*.

FIG. 4*b* is a transverse diagrammatic view of the slitted disk partition and associated elements, taken on the line 4*b*–4*b* of FIG. 4*a*, the hub being shown in phantom lines for clarity of illustration as in each of FIGS. 4 and 4*a*.

FIGS. 5, 5*a*, and 5*b* are respectively perspective, longitudinal section, and transverse diagrammatic views, partially in phantom for clarity of illustration similar to the views of FIGS. 4, 4*a*, and 4*b*, illustrating the opening of the slitted disk partition by the blunt ended slidable cannula.

FIGS. 6, 6*a*, and 6*b* are diagrammatic views similar to those of FIGS. 4, 4*a*, and 4*b*, 5, 5*a*, and 5*b*, and showing the respective positions of the two cannulas and the slitted disk partition in the fully open position.

FIG. 6*c* is an enlarged diagrammatic illustration of a portion of the upper corner section of the disk partition slit lips and the adjacent cannular wall, within the corresponding rectangular position of FIG. 6.

FIGS. 7, 7*a*, and 7*b* are similar to FIGS. 4, 4*a*, and 4*b*, and diagrammatically illustrate one possible normal configuration of the slitted disk partition after removal of the slidable cannula therefrom and reclosure of the slit.

FIGS. 8 through 10 illustrate various closure configurations of the slitted disk partition after removal of the slidable cannula therefrom.

Referring now in detail to the figures in the drawings, the invention is illustrated as applied to a multiple sample blood collecting assembly generally indicated at 11, including a valved needle connector assembly 21 which may be removably connected to a syringe barrel 51 for ease of sequential connection of the valved needle connector assembly 21 to successive blood collecting containers 61, as generally illustrated in FIG. 1 preparatory to container attachment.

The valved needle connector assembly 21 in the illustrative embodiment takes the form of a hub 25 which may be formed of maleable metal, such as aluminum, and having a venipuncture hollow needle or cannula 23 rigidly secured in its forward or nose end as by crimping as indicated at 25*c*. Cannula 23 may be provided with a suitable sharpened end 23*a*, as by forming a beveled point, as is conventional in the art. A protective sheath 24 (or sheaths) of plastic or other suitable material may be removably frictionably secured onto the hub 25 for protection and hygiene prior to time of usage in performing the desired venipuncture and blood sampling.

The hub 21 may be suitably removably secured to the nose end 52 of the syringe barrel 51, as through the medium of hub connector wings 25*h* which are removably inserted into wing-receiving bayonette slots 53*a'* formed on the forward or nose end wall 53 of the syringe barrel, and extending radially outwardly from the hub receiving central bore opening 53*a* formed in the forward wall 53. As in conventional bayonette slot connections, the wing receiving bayonette slot 53*a'* may be provided with quarter-turn laterally connecting securing slots to enable the securing of the hub connecting wings by insertion of the hub 25 with wings 25*h* into the bore opening 53 and slots 53*a'* and rotating the hub 21 a quarter-turn. As an aid in frictional retention of the hub connecting wings 25*h* within the slots 53*a'* an elastic retainer ring 33, which may be suitably formed of plastic, rubber, or the like, forms and defines the rear wall of slots 53*a'*, thereby providing a snug securing fit for the wings 25*h*. Retainer ring 33 may be suitably secured in place by an in-turned circumferential frictional retention lip 53*b* on the rear face of forward wall 53.

The valved needle connector assembly 21 further includes a second cannula 31 which is employed to puncture and effect fluid connection to a suitable collector device, which preferably is a suitably evacuated vacuum collection container 61 which may take the form of a glass vial 63 having a rubber stopper closure, such evacuated containers being conventional in the art.

Cannula 31 and cannula 23 are normally in fluid disconnection from one another, this fluid disconnection being effected by a slitted rubber partition 27, formed by disk having a precut slit, which is secured transversely within the hub 25 through the medium of a securing bushing seal element 29. As will be seen in FIGS. 2 and 3, the inner end 23*b* of the forward or venipuncture cannula 23 terminates within a chamber formed within the hub 25 and defined by a forward tapered wall 25*b* and the forward surface of the slitted rubber disk partition 27. Cannula 31 likewise has its inner end 31*b* terminating in its normal retracted position, within a chamber formed by the forward inner tapered wall of the securing bushing seal 29 and the interfacing rear wall of the slitted rubber disk 27. This chamber is normally substantially effectively sealed both from the forward chamber adjacent the end 23*b* of cannula 23 and from the outside atmosphere. To this end, the slitted disk 27 is secured in place within the hub 25 by compressive ring-pinching of the disk 27 against the shoulder 25*a* in hub 25 by the annular forward tapered bushing nose 29*b*, thereby effectively securing the disk 27 in place and forming a hermetic seal between the shoulder 25*a* and bushing nose 29*b*. In addition, the bushing 29 is provided with a frictional guide surface and seal section 29*c* of relatively short length, which effectively seals the inner end 31*b* and bore 31*c* of the cannula 31 relative to the outside atmosphere or other external environment about outer or butt end 31*a* of the cannula 31. This sealing action of the seal section 29*c* may be readily effected by forming this seal section of a slightly undersize to form an interference fit with the cylindrical outer surface 31*d* of the cannula 31.

Bushing seal 29 may be suitably secured within the hub 25 as by crimping or indenting the annular wall of the hub around, or at spaced positions around, its circumference, as indicated at 25*g*, to thereby anchor the bushing seal in place within the hub 25. Prior to and during effecting this crimp securing of the bushing seal 29 within the hub 25, it is desirable that the bushing seal 29 be pressed forward with its nose end 29*b* pinching into the rear wall of the seated disk 27 under pressure, the crimping 25*g* of the hub being effective to anchor the bushing seal 29 in place with the disk 27 compressed against the shoulder 25*h* by the ring nose 29*b* of the bushing seal. With slitted rubber disk 27 of approximately 40–50 durometer, approximately 0.030 inch thick and 0.160 inch diameter, and with a ring nose 29*b* diameter of 0.125 inch, and a transverse radius of curvature of the nose approximately 0.002 inch, it has been found that an axial compressive force of approximately 3 to 5 pounds acting on the bushing seal 29 toward the forward end of the hub 25 provides a desirable extent of pinching of the rubber disk 27, the tapered bushing nose 29*b* and shoulder 25*a*.

Bushing seal 31 may be suitably formed of acetel resin, such as that manufactured under the trade name Delrin, or of nylon or other relatively stable plastic material, although acetel resin is considered best due to its good strength at high heat, and the low coefficient of friction of this material to stainless steel, of which the slidable cannula 31 is normally formed, and the further property for acetel resin of dimensional stability under various storage conditions.

The shoulder 25*a* should have sufficient width to provide an adequate seating and sealing surface. It has been found that reliable seating of the plastic bushing seal 29 may be effected with a relatively sharp circular or ring-forming nose end 29*b*, engaging the disk partition in the zone backed by approximately the middle to the inner edge of the shoulder 25*a*. Thus, with an inside diameter of the large section of the hub 25, a disk 27 of approximately 0.030 thickness and outside diameter of approximately 0.160 inch, a suitable diameter of the

tapered bushing nose 29*b* may be 0.125 inch. These dimensions are suitable for cannula tubing diameters of approximately 0.036 inch.

The slitted disk partition 27 is provided with a diametrally extending slit 27*a*, formed as by cutting with a sharp knife, the lips 27*aa* of which slit are normally held in a contiguous interfacing relation by the elastic nature of the rubber material forming the partition 27. It has been found that ethylene propylene rubber is satisfactory as the material for the disk partition 27, particularly as it will withstand the heat of sterilization, although it does not have the best mechanical characteristics. In the small sizes of the illustrative embodiment, silicone rubber has been found to have insufficient strength to withstand penetration by the end of the cannula without some tearing. Other rubbers having better mechanical characteristics may be utilized, including natural rubber, and other synthetic rubbers, although most other such rubbers require the use of gas or chemical sterilization rather than heat sterilization, due to deterioration at the high heat sterilization temperatures normally employed. However, if gas or chemical sterilization is acceptable in a given instance or if other sterilization may be sufficiently effective, or if sterilization is not required, it will be apparent that such other rubber compounds or other elastic materials of better mechanical characteristics may be employed in such instances, as may be desired. Slit 27*a* extends part way across the zone formed by the annular inner surface of the shoulder 25*a*. With the shoulder 25*a* having an outer diameter of approximately 0.159 inch and an inner edge diameter of approximately 0.100 inch, an ethylene propylene rubber disk 27 of approximately 0.159–0.160 diameter and a disk 27 thickness of approximately 0.028–0.031 inch, and with the outer diameter 37*d* of the cannula 31 being expended at its flared inner end from its cylindrical outer diameter of 0.036 inch to 0.042 inch outer diameter, it has been found that approximately 0.094 inch is a suitable transverse length for the slit 27*a*.

Cannula 31 is axially slidable within the bushing seal 29 toward and away from the slitted disk 27 to effect opening of the slit lips 27*aa* during interposition thereof within the lips, and self-reclosure of the lips 27*aa* upon withdrawal of the cannula 31 from between the lips 27*aa* and away from the disk 27. In order to prevent the slidable cannula 31 from being pulled out of the bushing seal 29, the inner end of 31*b* of the slidable cannula is flared as with a suitable flaring tool. As noted above, in one illustrative embodiment employing 0.036 inch diameter tubing for cannula 31, a flaring of the end 31*b* to an outer diameter of 0.042 inch has been found to be satisfactory. While symmetrical flaring is desirable, as shown, it has been found that such is not necessary for operability in retaining the cannula 31 in place and in effecting the desired opening and closure-enabling of the slitted disk partition 27. The flared end 31*b* may be slightly rounded at its outer peripheral edge surface, if desired, to aid in smoother opening of the slit 27*a* and to reduce possible surface abrasion action thereby on the disk 27 in opening the slit 27*a*. While other retention stop means may be formed on the cannula 31 as by adding or forming a flange rearwardly of the inner end 31*b*, such are normally more expensive and less desirable than the simple flared end stop as illustrated.

The outer opposite or butt end 31*a* of the cannula 31 is suitably pointed for penetration of the rubber stopper 65 secured in the end of the vial 63. To this end, the pointed end 31*a* may be suitably formed as indicated in FIGS. 1 and 2, as by first forming a beveled point and then bending such toward the central axis of the needle.

In operation, as illustrated in the succeeding FIGS. 4–7, taken in conjunction with FIGS. 1 and 2, the venipuncture cannula 23 is inserted into the patient's vein, with the slidable cannula 31 being in the normal or cutoff position as illustrated in each of FIGS. 1–4. With the cannula 23 in the patient's vein, the evacuated blood collection container 61 is moved to the forward end of the syringe barrel 51 bringing the rubber stopper 65 into contact with the pointed butt end 31*a* of the cannula 31.

Further forward movement of the container 61, while holding the syringe barrel 51, causes the butt end point 31*a* to embed itself in the rubber stopper 65, thereby closing the open butt end of the cannula 31. This action also starts the forward motion of the slidable cannula toward the disk partition 27, causing the disk partition 27 to be engaged by the flared inner end 31*b* of the cannula 31.

Continued forward motion of the container 61 causes the flared inner end 31*b* of the cannula 31 to push the lips 27*aa* of the slit apart, as indicated in FIGS. 5, 5*a*, and 5*b*, the cannula 31 then continuing to move between the parted lips 27*aa* until its inner end 31*b* engages with the interfacing inner end 23*b* of the fixed cannula 23. Thus fluid communication is established between the respective interior bores 23*c* and 31*c* of the two cannulas 23 and 31 immediately upon opening of the lips as indicated in FIG. 5, as well as in the forwardmost position of the cannula 31 as indicated in FIG. 6. It will be noted that the parted lips form a generally cat-eye appearance, being generally puckered forwardly toward the cannula 23 in the open position. There will normally be a small eye opening 27*abc*, formed between the adjacent parted lips 27*aa* at the junction immediately adjacent the outer cylindrical anular surface 31*d* of the cannula and the lip corner junction zone. This small eye opening may be fairly minute, as the lips 27*aa* tend to stay in contact along a substantial length thereof adjacent the outer corner of the slit, as indicated along the line 27*ab* in FIG. 6*c*. However, it has been found that normally a small eye opening will be present, as indicated at 27*ab*, on both sides of the tube at the corner junction of the tube wall 31*d* with the lip interface, this small eye opening being approximately 0.001–0.005 inch in the illustrative general size range discussed above. Upon some retraction or withdrawal of the cannula end 31*b* toward the disk partition 27, the forward puckering of the lips 27*aa* will be generally eliminated, and the small eye opening 27*abc* may tend to be larger. In view of the substantially hermetic sealing effected about the periphery of the rubber disk partition 27, by the shoulder 25*a* and tapered bushing nose 29*b* on the one hand and the interference fit of seal section 29*c* with the outer cylindrical surface 31*d* of cannula 31, the fluid connection effected between the two chambers on each side of the disk partition 27 by the small eye opening 27*abc* does not effect connection of the bores 23*c* and 31*c* of the cannulas to the outside atmosphere.

Upon the cannula 31 sliding forwardly to the position of FIG. 6, and abutting the facing adjacent end 23*b* of fixed cannula 23, continued forward motion of the container 61 toward the nose end of the syringe barrel will result in corresponding further penetration of the cannula 31 in and through the stopper 65. Upon the emergence of the open pointed end 31*a* of the cannula into the interior of the glass vial 63, it will be seen that full fluid connection is thereby effected between the patient's vein and the interior of the glass vial 63, through the medium of the fluid flow interconnected cannulas 23 and 31. Due to the evacuated condition of the glass vial 63, the blood will thereupon flow through the cannulas 23 and 31 into the glass vial 63.

When a desired quantity of blood has been collected in the glass vial 63, it is only necessary for the operator to withdraw the container 61 from the syringe barrel 51 to effect cutoff of the blood flow through the cannulas 23 and 31. During the initial withdrawal action of the container 61, the frictional resistance between the cannula 31 and the rubber stopper 65 will effect motion of the cannula 31 with the stopper 65, thereby sliding the cannula 31 rearwardly through the slit 27*a* to its initial quiescent stop position as shown in FIGS. 1–4 and 7. Further withdrawal movement of the container 61 will result in the stopper being pulled off and separated from the slidable cannula 31. However, inasmuch as the cannula 31 has already moved to its rearmost position, the slide 27*a* will have thereupon been reclosed under the self-reclosing elastic action of the rubber disk partition 27. Accordingly, the valved needle connector assembly 21 is again in closed position and ready for the connection thereto of a further blood container 61, following the same container connection and disconnec-

tion steps described above. Thus, succeeding individual samples of blood may be taken with individual evacuated containers **61** or other suitable containers or receptacles without effecting loss of blood through the needle connector assembly in the periods prior to, between, or after the sample collections.

While slide **27***a* may reclose to a position essentially as shown in FIG. **4**, with the two opposite faces of the disk partition **27** essentially flat, and the lips **27***aa* essentially restored to their initial coplanar position, such is not always the case, as in some instances various slightly differently configured return positions of the lips **27***aa* will be effected in the closed position thereof upon withdrawal of the flared end **31***b* of cannula **31** therefrom. One such form is schematically shown in FIGS. **7**, **7***a*, **7***b*, and **8**, in which the slit tends to form something of a dimple on its forward face, with a corresponding slight surface raising in the zone of the slit **27***a* on the rear face adjacent to cannula **31**. Nevertheless, the lips **27***aa* in such instance are in fact effectively closed and in contiguous relation with one another, and the desired fluid disconnection between the two cannulas **23** and **31** is effected, with consequent shutoff of fluid flow. Such slit puckering or indenting of the disk surface on the forward face is though to be the result of the withdrawal action of the flared end **31***b* of cannula **31**, and the slightly uneven springback action which may result between the two lips as the flared end leaves the slit lips **27***aa*.

Other encountered reclosure conditions of the lips **27***aa* are indicated in FIGS. **9** and **10**. The return configuration of FIGS. **9** and **10** may be brought about by uneven or assymetrical formation of the flared end **31***b*. However, notwithstanding the slight pucker or assymetrical formation of the reclosed lips **27***aa*, they are nevertheless in contiguous interfacing relation in this reclosed condition and thereby effect the desired fluid cutoff.

In this respect, the fluid cutoff of a control valve for blood collection purposes may normally be considered to be effective if the valve will withstand a pressure differential of approximately 10 centimeters of water. The present illustrative embodiment has been found to be quite adequate for this purpose, and in fact may be made to withstand substantially higher differential pressures for this and other purposes as may be required, by suitable variation in the thickness and size of the valve partition **27** and the other associated parts. Thus, while the invention is particularly applicable to, and finds particular utility, in the medical field for enabling the collection of multiple samples of blood from a single venipuncture, the invention is in fact useful as a general purpose valve arrangement and may also be used for other medical applications requiring selective valve cutoff action. In this respect, the sliding action of the cannula or tube **31** may be accomplished in other desired manners than through the intercoupling thereof to a collection vial stopper, as for instance by manual shifting of the cannula forward and rearwardly as may be desired. In such instance, the cannula **31** may form a simple tube which may itself be connected through rigid or flexible tubing to another fluid source or discharge point, and the cannula **23** may or may not in such instance be pointed, as the indicated use may require.

It has been found that the single straight slit is highly superior to other possible slit formations for this invention, as other configurations tend not to fully close, and have other mechanical drawbacks. The most desirable and repeatedly successful form of slit is effected by two contiguous interengaging slit lips which are elastically returned into contiguous relation upon withdrawal of the slidable cannula.

While the invention has been illustrated and described with respect to a single illustrative and preferred embodiment, it will be apparent to those skilled in the art that various modifications and improvements may be made without departing from the scope and spirit of the invention. For instance, in addition to those variations discussed supra, the general valve construction formed by the two tubes and separating slit partition may be utilized in other configurations and for other purposes than as herein illustrated. Also, while the illustrated embodiment employs a wing connection **25***h* for connection with a bayonette slot opening, the valved connector assembly **21** may employ a hub **25** or other housing which has a different mode of connection to a syringe barrel or other unit; as for instance, the hub assembly may incorporate a male threaded portion on the rear thereof for threaded engagement with a complementary female threaded opening in a syringe barrel or other user attachment. Accordingly, the invention is not to be limited by the particular illustrative embodiment but only by the scope of the appended claims.

That which is claimed is:

1. A valved needle arrangement comprising:
a housing having a cavity formed therein,
first and second cannulas connecting with said housing and each having an open end thereof connecting in fluid flow relation with a portion of said cavity,
an elastic partition in said housing cavity and normally separating said cannulas in fluid flow disconnection from one another,
said partition having a pre-formed self-closing transverse slit therein and extending therethrough and with interfacing normally contiguous lips for passage accommodation therethrough of one of said cannulas to enable fluid flow communication between said cannulas,
one of said cannula being longitudinally slidable toward and away from said partition and being generally longitudinally aligned with said pre-formed slit,
said one slidable cannula having a blunt end movable within said cavity and selectively engageable with said partition in the zone of said slit to laterally separate and open the normally closed lips of said slit in said partition as a function of longitudinal sliding movement of said one cannula toward and into lip-parting engagement with said partition; the lips of said partition slit being elastically self-closing upon longitudinal movement of said one cannula away from said partition.

2. Apparatus according to claim **1**,
second said cannula being in fixed relation with said housing.

3. Apparatus according to claim **1**,
at least one of said two cannulas having a pointed puncture-effecting end at its outer end.

4. Apparatus according to claim **3**,
both of said two cannulas having pointed puncture-effecting outer ends.

5. Apparatus according to claim **4**,
said second cannula being secured in fixed relation in said housing.

6. Apparatus according to claim **1**,
said one slidable cannula having a transversely extending stop formed thereon and disposed within said cavity to limit longitudinal movement of said one cannula.

7. Apparatus according to claim **6**,
said stop comprising an enlargement of the blunt inner end of said one cannula.

8. Apparatus according to claim **7**,
said cannula enlargement comprising a flared end of said one cannula.

9. Apparatus according to claim **1**,
said slit being linear and forming a cat-eye shape upon lip-separation by passage of said one cannula therethrough.

10. Apparatus according to claim **9**,
said cat-eye shape slit opening forming lateral apertures on opposite lateral sides of said one cannula.

11. Apparatus according to claim **10**,
said housing having a bushing portion forming a close interference fit sleeve seal about said one cannula for sealed sliding friction fit therebetween,
and said housing being effectively unitary with the other said cannula.

12. Apparatus according to claim **10**, further comprising
a vacuum-operating liquid collecting container engageable in fluid-flow relation with said one slidable cannula,

said one slidable cannula being slidable toward and away from said partition as a function of connection and disconnection thereof with said container.

13. Apparatus according to claim 1,

said pre-formed slit having a straight line configuration with parallel interfacing contiguous lips.

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