Aug. 26, 1958 R. F. McGREW ET AL 2,848,999

SAMPLING APPARATUS

Filed Nov. 13, 1952

2 Sheets-Sheet 1

Fig. 1

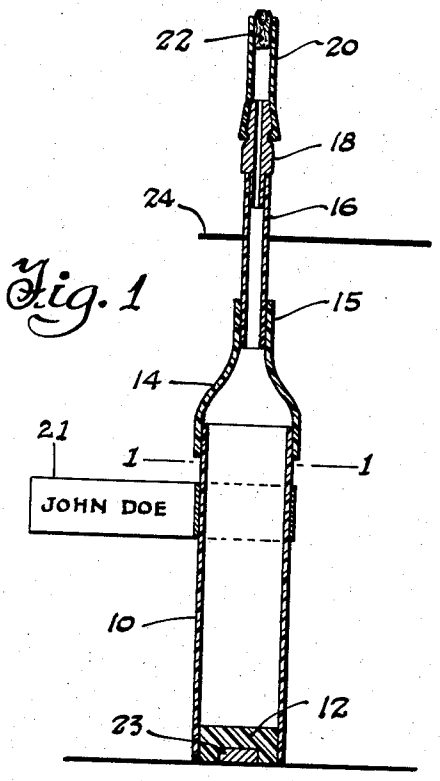


Fig. 3

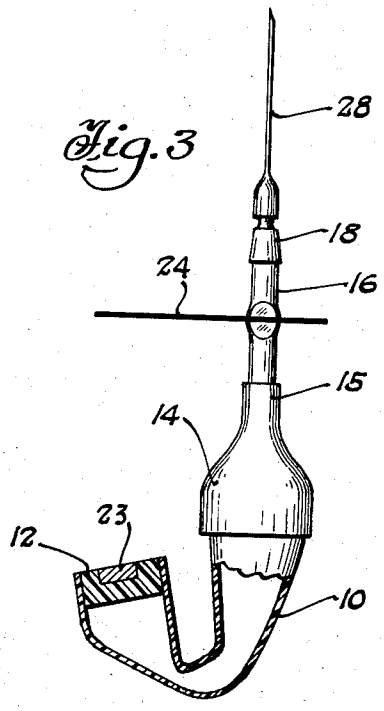
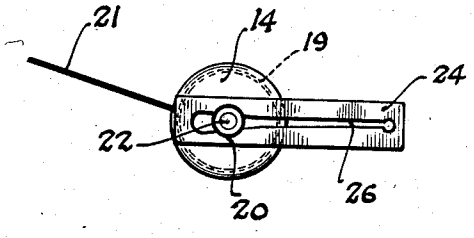


Fig. 2



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2 Sheets-Sheet 2

Fig. 4

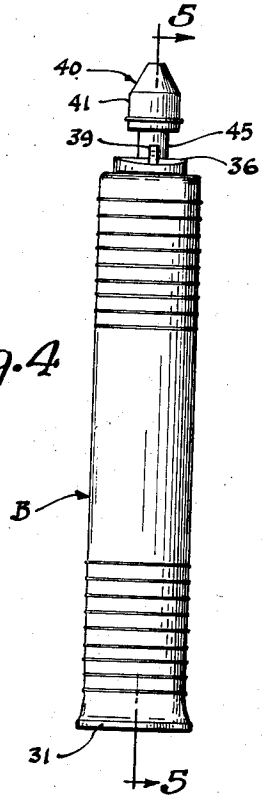


Fig. 6A

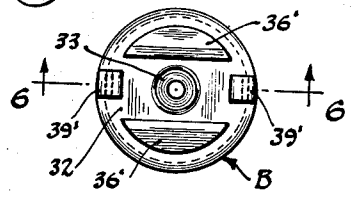


Fig. 5

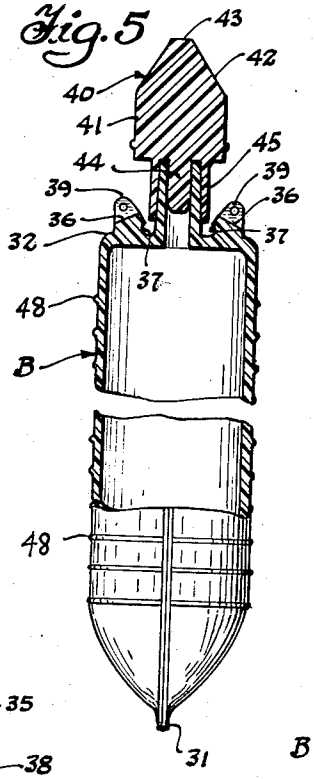


Fig. 6

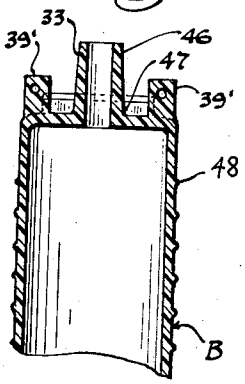


Fig. 7

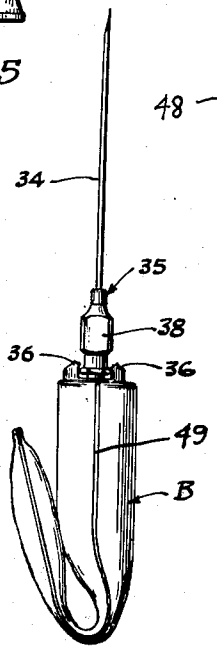
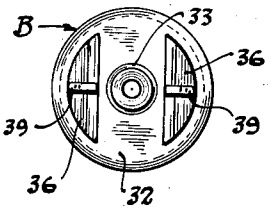


Fig. 5A



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SAMPLING APPARATUS

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Application November 13, 1952, Serial No. 320,332

14 Claims. (Cl. 128—276)

This invention relates generally to fluid sampling apparatus and more particularly to a disposable, unitary, plastic blood sampling unit.

Included among the objects and advantages of the present invention is a disposable syringe for collecting a sample of blood, which syringe also functions as a dropper, a centrifuge tube and a test tube. Further, the device is a sterilized unit package adapted for one and only one blood sample.

The general apparatus used heretofore for blood sampling, consisted mainly of a glass hypodermic syringe, and several test tubes including centrifuge tubes, test tube racks, medicine droppers, etc. The glass syringe normally had a detachable hypodermic needle, and since the two were used to draw blood from the patient, they had to be autoclaved with steam or boiled in water to insure sterility. Under the constant temperature changes from such sterilization, the glass syringes were only usable for about 20 samplings. Furthermore, the extensive handling of the syringes and tubes for washing, sterilizing, and so forth, including a large percentage of breakages, made the procedure unduly expensive.

A major disadvantage of the common blood sampling method is the transmittance of viral diseases, such as hepatitis, from patient to patient due to faulty sterilization. Few medical offices or laboratories are equipped with high pressure steam autoclaves capable of giving adequate sterilization of the equipment to prevent the transmitting of such viral diseases.

Generally, the present invention comprises a transparent, or at least a translucent, resilient plastic tube having one closed end, and an outlet at the opposite end, and means on the outlet available for directing a blood sample into the tube.

The device of the invention and the mode of operation thereof may be more fully understood by reference to the following description thereof, and the accompanying drawings, in which:

Figure 1 is a vertical sectional view of a device according to the invention;

Figure 2 is a plan view of the device shown in Figure 1;

Figure 3 is an elevation of a device according to the invention in one operative position;

Figure 4 is a side elevation view of a modified form of the device;

Figure 5 is an enlarged vertical sectional view along the lines 5—5 in Figure 4;

Figure 5*a* is a plan view of the device shown in Figure 5 with the cap removed;

Figure 6 is an enlarged fragmentary vertical sectional view of a still further modification of the device shown in Figure 5.

Figure 6*a* is a plan view of the device shown in Figure 6; and

Figure 7 is a side elevation view of the device shown in Figure 4 in one operative position.

The blood sampling device illustrated in Figures 1 and 3 comprises a main tube body **10** of resilient, clear

extruded plastic, having walls sufficiently strong to resume normal shape after being distorted. One end of the tube **10** is closed by a cylindrical plug **12**, sealed therein by heat or solvent. The opposite end of the tube **10** is closed by cap **14** which is likewise sealed onto the tube. The cap **14** tapers to a small outlet neck **15**, into which is sealed a short section of resilient extruded plastic tubing **16**. A tubing clamp **24** is placed on the tubing **16**, and a needle adapter **18** is sealed on the outer end of the tubing **16**. A small tubular cap **20** fits over the needle adapter, and the end thereof is closed by a piece of sterile cotton **22**. The tubing clamp **24** as shown is a thin piece of metal having a tapered slot **26** available for pinching the tube.

After assembly, the device is sterilized and packaged in a suitable container for shipment to point of use. In operation, the sampling device is bent or folded double, as indicated in the configuration of Figure 3, and the tubing clamp **24** is moved to force the tubing into the narrow end of the slot **26**, closing the tubing. In the distorted shape, the volume of the tube **10** is materially decreased. Closing the outlet tubing while the volume is thus decreased and releasing the main tube leaves a partial vacuum in the sampling device. The cap **20** is then removed, and a hypodermic needle **28** is attached to the needle adapter **18**. The needle is then inserted into a patient's vein, and the tubing clamp is slowly moved to open position. The partial vacuum of the device assists in drawing blood from the patient's vein into the sampler.

Alternatively, without any pinch clamp, the user can merely double up the tube, as indicated in Figure 3, and hold it inside his hand, collapsed by manual pressure, while the needle is inserted. Then it is only necessary to release the pressure on the body **10** to initiate the withdrawal of blood.

When sufficient blood has been drawn into the sampler, the pinch clamp is again moved to closed position, and the needle withdrawn from the patient's vein. The needle is disassembled from the device, and the device may be sent to the laboratory for blood testing.

Where required, the clamp in the device may be opened, the sampling unit inverted, and by gently squeezing the main tube **10**, drops of blood may be dispensed where desired, as for samples for various blood tests. The whole unit may be placed in a centrifuge for separating the blood cells from the plasma. With or without centrifuging, the top may be severed along line 1—1, leaving a small plastic test tube which will stand upright, due to the square base formed by the plug **12**. A small weight **23** may be embedded in the bottom of plug **12** to increase stability.

Especially in sizes up to 20 ml., with commercial plastic tubing of an inside diameter of the order of magnitude of ⅝ of an inch and a wall thickness of .05 of an inch, a simple tube has enough mechanical strength to exert a substantial suction and expedite the flow of blood into the device, so that the time required to take the sample can be substantially reduced.

In a large hospital where many samples need to be taken, the devices can be packed in individual boxes or in sets of a dozen or more, separated by paper partitions, each device carrying an identification tab affixed thereto. Such a tab may be a mere strip of paper **19**, with a little adhesive on one side, wrapped around the body **10** near the top, with a portion projecting as indicated at **21**. For packaging, the projecting portion **21** can be conveniently wrapped around the body.

Thus the operator pulls one of the devices out of the carton, writes on the tab such identifying indicia as may be desired, fills the device with the patient's blood and seals the filled container with the pinch clamp **24**. The

container is then a non-breakable, completely identified unit, which can be put back in the original package from which it is withdrawn or accumulated in a pocket or basket and delivered to the laboratory, fully identified and ready for processing.

In the laboratory, each of the devices can be put into a centrifuge without removing the tab, centrifuged, cut off along the line 1—1 and placed upright on a laboratory bench, where it will stand firmly while the laboratory worker makes any desired tests and inspection and fills out a report for the use of the medical staff.

The modified form of the invention shown in Figures 4 through 7 and designated generally by B comprise a main tube body of resilient, plastic tubing such as polyethylene plastic, having walls sufficiently transparent to permit observation of the interior thereof and sufficiently strong to resume normal shape after being distorted. One end of the tube body is normally closed by heat or solvent sealing the walls of the tube body together along one extremity thereof forming a transverse seal **31** at one end of the tube body. The opposite end of the tube is partially closed by an end closure member **32** having the circumferential configuration of the tube body and which may be heat or solvent sealed in the open end of the tube body but which is preferably molded integrally therewith, thereby forming an integral part of the tube body. The end closure member **32** has an axially alined tube or hypodermic needle adapter **33** integrally formed thereon which is tapered to the approximate dimensions of a standard luer taper (0.170 in. diameter at ¼" from the tip and tapering at 3° 26′ to the larger end) for attaching a cannula **34** of a hypodermic needle **35** thereto and which serves as a means for conducting liquids into the interior of the said tube body. The taper of the adapter **33** is preferably made to provide a slight interference with the needle hub in order to hold the hub more securely.

Preferably on the upper surface of the end closure member **32** are disposed two segmentally shaped blocks **36** which serve as a means for locking the hypodermic needle in place and which are preferably molded integrally with the end closure member symmetrically disposed on opposite sides of the needle adapter **33**. The oppositely disposed inner surface of the segmentally shaped blocks are under cut slightly as at **37** to receive and frictionally engage the hub **38** of the hypodermic needle **35**, thereby locking the needle in place on the end of the tube. If desired, other means for locking the needle hub on the adapter **33** may be employed or the locking means may be omitted altogether. Preferably, also on the upper surface of the end closure member **32** medially on the upper surface and the segmentally shaped sections **36** (Figure 5*a*) or between the outer ends of the segmentally shaped sections **36′** (Figure 6*a*) are mounted preferably integrally there with small sections of plastic **39** and **39′**, respectively which are either readily penetrable or have an opening transversely therethrough for receiving a pin or other fastening means for securing the tube to the patient's apparel. If preferred, however, the means for pinning or securing the tube to the patient's apparel may be affixed to the lower end of the tube body, as by forming a tab extending longitudinally from the sealed section at the lower end.

The needle adapter **33** is normally protected by means of a protective sealing cap **40** when the hypodermic needle is not positioned on the needle adapter **33**. The cap member **40** is preferably comprised of a rigid generally cylindrical main body section **41** which can be readily grasped by the operator. The upper portion of the cap **40** is preferably frustoconical in shape having conical walls **42** thereof designed to fit the taper of a standard conical centrifuge tube and the flat upper surface **43** thereof designed alternatively to be accommodated by the flat bottomed centrifuge tube of the standard centrifuge. Projecting outwardly from the lower surface of the cylindrical body section of the cap member **40** is an axially

alined cylindrical plug **44** having an outside diameter substantially the same as the inside diameter of the axial passage through the needle adapter **33** and having a length less than that of the said needle adapter **33**. Also projecting from the lower surface of the cylindrical body **41** of the cap and disposed concentrically about the axial plug **44** is an outer cylindrical sleeve **45** having an interior diameter slightly greater than the exterior diameter of the outer end **46** of the tapered needle adapter **33** and an interior diameter slightly less than the exterior diameter of the inner end **47** of the said tapered needle adapter **33**.

When the sealing cap **40** is seated on the needle adapter **33** the axial plug **44** fits within the passage through the needle adapter **33** and forms a primary seal inside the said adapter. Simultaneously, as the plug **40** seals the interior of the passage through the adapter **33**, the cylindrical sleeve **45** frictionally engages the outside of the tapered needle adapter **33** and forms a secondary seal on the outer surface of the tapered needle adapter **33**. When the sealing cap **40** is fully seated and the primary and secondary seals are formed, the cap **40** is securely held in position on the needle adapter **33** and will not become accidentally disengaged therefrom during the vigorous handling or when the tubes are centrifuged during serological examination of a blood sample. The modified forms of the blood sampling tube heretofore described and shown in Figures 4 through 7 are sterilized and packaged in a suitable container in the usual manner.

In using the latter embodiments of the invention to collect a sample of blood, the cap member **40** is removed and the standard hypodermic needle **35** with luer taper is locked in position on the needle adapter **33** in the normal manner by rotating the hub **38** of the needle about 90° after it is fully seated on the adapter **33**. After the hypodermic needle has been locked in position and immediately prior to collecting the blood sample the lower half of the tube is folded upwardly and the walls of the tube compressed between the operator's thumb and forefinger, thereby forcing a substantial amount of the air out of the tube and when the pressure on the tube is released creating a partial vacuum within the tube. The hypodermic needle cannula **34** is then inserted into the patient's vein while the tube is held in the folded and compressed position. When the tube is released and allowed to return to its normal expanded position, the partial vacuum created within the tube assists greatly in collecting the blood sample and reduces the time required for collection to a minimum. When a sufficient volume of blood has been collected as indicated by inspection or markings on the side of the tube, the needle is removed from the patient's vein in the usual manner and the hypodermic needle **35** removed from the needle adapter **33**. The sealing cap **40** is immediately press fitted onto the needle adapter **33**, thereby sealing the tube and securing the cap in position. While unnecessary when proper interferences are provided, the lower end of the sleeve **45** of the cap **40** can be provided with projections such as those of the lower end of the hub of the hypodermic needle so that the cap can be locked in place in the same manner the needle is locked in place. In each of the foregoing operations, the manipulation of the tube is facilitated by the several ridges **48** extending circumferentially about the tube adjacent the top and bottom thereof. If desired, indicia may also be placed on the walls of the tube to indicate the volume of liquid sample collected. Also extending longitudinally of the tube body are two strengthening ribs **49** on each side of the tube body which serve to prevent cracking of the tube body when flexing and to increase the resiliency of the tube body.

When only a few drops of blood are desired for testing, the sealing cap **40** of the blood sampling tube B is removed and the tube body squeeze until the desired amount of blood is forced outwardly through the passage in the needle adapter **33**. The tube B can be resealed

by firmly reseating the cap **40** on the adapter **33**. The tube B can be placed in a standard centrifuge having either the flat bottomed or conically tapered tube holders with the sealing cap **40** extending downwardly and the desired separation of the blood achieved without unsealing the tube and exposing the contents therof. To examine the separated fractions of blood, it is unnecessary to invert the tube or to remove the cap member **40**. Thus, access to the contents of the tube can be most conveniently had without mixing the separated fractions by cutting through the walls of the tube along a line spaced slightly inwardly of the transverse seal **31** at the lower edge of the tube. By cutting across the tube in the above manner a container similar to the standard test tube is obtained which facilitates the subsequent examination of the blood fractions.

An additional feature embodied in the latter modified form of the invention which greatly increases the usefulness of the blood sampling tube is the means provided for securing a tube to the apparel of the patient. Thus, for example, it is possible for an emergency aid station attendant to obtain a sample of a patient's blood in the plastic tube and attach the sealed tube to the wounded patient's clothing by means of a pin or the like so that when the wounded patient arrives at the base hospital an attendant will be immediately able to make the necessary tests on the patient's blood without delay resulting in further injury to the patient. The said means provided are preferably symmetrically disposed and balanced in order to facilitate using the tubes in a centrifuge.

This application is a continuation-in-part of our copending U. S. patent application Serial No. 208,561, filed January 30, 1951, now Patent No. 2,655,152.

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 our invention, we desire to claim the following subject matter.

We claim:

1. A fluid sampling device comprising a section of deformable resilient tubing having one end closed and the other end supporting an end closure member permanently secured therewith and having extending outwardly therefrom a tube of substantially smaller diameter than the said resilient tubing having an unobstructed axial passage therethrough directly communicating with the interior of the said tubing, said tube having means for detachably securing on one end thereof a hub of a hypodermic needle, and cover means enclosing the said means for accommodating the hub of a hypodermic needle and for sealing the said tube to prevent contamination of the interior of the said tubing and dissipation of the contents thereof which detachably engages the said means for securing the hub of a hypodermic needle, said sampling device exerting a substantial suction when expanding after being deformed and thereby assisting the flow of fluid into the said device.

2. A fluid sampling device comprising a section of deformable resilient tubing having one end closed and the other end supporting an end closure member permanently secured therewith and having extending outwardly therefrom a tube of substantially smaller diameter than the said resilient tubing having an unobstructed axial passage therethrough directly communicating with the interior of the said tubing, said tube having means for detachably securing on one end thereof a hub of a hypodermic needle, and a protective cover inserted over the end of the said tube which detachably engages the said means for detachably securing the hypodermic needle hub, said resilient tubing exerting a substantial suction when expanding after being deformed, thereby assisting the flow of fluid into the said device.

3. A blood sampling device comprising a section of a substantially cylindrical deformable resilient tubing having the walls thereof at one end sealed together closing the said end, an integral end closure means at the other end of said tubing having a relatively short rigid tube of substantially smaller diameter than the said resilient tubing integral therewith and extending outwardly therefrom, said tube having an unobstructed axial passage therethrough which affords unobstructed access to the interior of the said tubing, said short tube having the outer end thereof tapered for detachably securing thereto the hub of a hypodermic needle, and a removable protective cover over the said short tube sealing the end thereof which engages said tapered end of said tube, said sampling device exerting substantial suction when expanding after being deformed, thereby assisting the flow of blood into the said device.

4. A blood sampling device comprising a section of a substantially cylindrical deformable resilient tubing having the walls thereof at one end sealed together closing the said end, an integral end closure means at the other end of said tubing having a relatively short rigid tube of substantially smaller diameter than the said resilient tubing integral therewith and extending outwardly therefrom, said tube having an unobstructed axial passage therethrough affording access to the interior of the said tubing, said end closure means having means spaced outwardly from the said tube for securing the said fluid sampling device to an inanimate object, said short tube having the outer end thereof tapered for detachably securing thereto the hub of a hypodermic needle, and a removable protective cover over the said tube sealing the end thereof which engages said tapered end of said tube, said sampling device exerting a substantial suction when expanding after being deformed, thereby assisting the flow of blood into the said device.

5. A blood sampling device comprising a section of a substantially cylindrical deformable resilient tubing having the walls thereof at one end sealed together closing the said end, an integral end closure means at the other end of said tubing having a relatively short rigid tube of substantially smaller diameter than the said resilient tubing integral therewith and extending outwardly therefrom, said tube having an unobstructed axial passage therethrough which affords access to the interior of the said tubing, said end closure means having means spaced outwardly from the said short tube for engaging the hub of a hypodermic needle, said short tube having the outer end thereof tapered for detachably securing thereto the hub of a hypodermic needle, and a removable protective cover over the said short tube sealing the end thereof which engages the said tapered end of said short tube, said sampling device exerting substantial suction expanding after being deformed, thereby assisting the flow of blood into the said device.

6. A blood sampling device comprising a section of a substantially cylindrical deformable resilient tubing having the walls thereof at one end sealed together closing the said end, an integral end closure means at the other end of said tubing having a relatively short rigid tube of substantially smaller diameter than the said resilient tubing integral therewith and extending outwardly therefrom, said tube having an unobstructed axial passage therethrough which affords access to the interior of the said tubing, said end closure means having at least one outwardly projecting tab which facilitates securing the said sampling device to a patient's clothing, said short tube having the outer end thereof tapered for detachably securing thereto the hub of a hypodermic needle, and a removable protective cover over the said short tube sealing the end thereof which engages the said tapered end of said short tube, said sampling device exerting substantial suction when expanding after being deformed, thereby assisting the flow of blood into the said device.

7. A blood sampling device comprising a section of a substantially cylindrical deformable resilient tubing having the walls thereof at one end sealed together closing the said end, an end integral closure means at the other end of

said tubing having a relatively short rigid tube of substantially smaller diameter than the said resilient tubing integral therewith and extending outwardly therefrom, said tube having an unobstructed axial passage therethrough which affords access to the interior of the said tubing, said end closure means being substantially rigid and resistant to deformation when the walls of the said tubing are deformed, said short tube having the outer end thereof tapered for detachably securing thereto the hub of a hypodermic needle, and a removable protective cover over the end of said short tube sealing the end thereof which engages the said tapered end of said short tube, said sampling device exerting substantial suction when expanding after being deformed, thereby assisting the flow of blood into the said device.

8. A blood sampling device comprising a section of a substantially cylindrical deformable resilient tubing having the walls thereof at one end sealed together closing the said end, an integral end closure means at the other end of said tube having a relatively short rigid tube of substantially smaller diameter than the said resilient tubing integral therewith and extending outwardly therefrom, said tube having an unobstructed axial pasage therethrough which affords access to the interior of the said tubing, said short tube having the outer end thereof tapered to accommodate the hub of a hypodermic needle, and a removable protective cover over the end of said short tube sealing the end thereof which engages the said tapered end of said short tube, said cover having means for being secured in sealed position on the said short tube protecting the said tapered end and the interior of said tubing against contamination, said sampling device exerting a substantial suction when expanding after being deformed, thereby assisting the flow of blood into the said device.

9. A blood sampling device comprising a section of a substantially cylindrical deformable resilient tubing having the walls thereof at one end sealed together closing the said end, an integral end closure means at the other end of said tubing having a relatively short rigid tube of substantially smaller diameter than the said resilient tubing integral therewith and extending outwardly therefrom, said tube having an unobstructed axial passage therethrough which affords access to the interior of the said tubing, said short tube having the outer end thereof tapered for detachably securing thereto the hub of a hypodermic needle, and a removable protective cover over the said short tube sealing the end thereof which engages the said tapered end of said short tube, said protective cover having a plane supporting surface at the outer end thereof suitable for inserting the device in an inverted position into a tube holder of a standard centrifuge.

10. A blood sampling and dispensing device comprising a length of substantially transparent cylindrical tubing of resilient plastic material, the said tubing having the walls at one end thereof sealed together to form a transverse seal closing the end of the said tubing, the other end of said tubing partially closed by an integral transverse end closure means integral therewith and having extending therethrough a short relatively rigid non-deformable tube in alignment with the axis of the said tubing which extends outwardly therefrom, said tube having an unobstructed axial passage communicating with the interior of said tubing and having the end thereof tapered to detachably retain on the outer surface thereof the hub of a hypodermic needle, said tube being the only inlet and outlet for the said device, and a protective closure member extending over the end of said tube sealing the end of the said tube having means for engaging the inside and outer tapered lateral surfaces of the said tube simultaneously, said tubing being sufficiently resilient to return to its original shape after being compressed, thereby exerting a substantial suction when expanding to assist the flow of fluid into the interior thereof.

11. A fluid sampling device comprising a section of deformable resilient tubing having one end closed and the other end supporting an end closure member having a small diameter tubular member extending outwardly from said resilient tubing forming a restricted discharge opening, said tubular member having an unobstructed axial passage communicating directly wtih the interior of the said resilient tubing and also having means at the outer end thereof for detachably securing thereto a hub of a hypodermic needle, and cover means removably engaging the said means for accommodating the hub of a hypodermic needle and sealing the end of said tube to prevent contamination of the interior of the said tubing, said sampling device exerting a substantial suction when expanding after being deformed and thereby assisting the flow of fluid into the said device.

12. A blood sampling device comprising a section of a substantially cylindrical deformable resilient tubing having the walls thereof at one end sealed together closing the said end, an integral end closure means at the other end of said tubing having a relatively short rigid tube of substantially smaller diameter than the said resilient tubing integral therewith and extending outwardly therefrom which affords unobstructed access to the interior of the said tubing, said short tube having the outer end thereof tapered to accommodate the hub of a hypodermic needle, and a removable protective cover over the said short tube sealing the end thereof, said protective cover having a conically tapered lateral outer surface and a flat outer end surface providing an end structure suitable for inserting in an inverted position into the conically tapered tube holder of a standard centrifuge and supporting the said sampling device in inverted sealed position.

13. In a liquid container structure having a substantially tubular body section and an integral short rigid tube of substantially smaller diameter extending outwardly therefrom at one end providing the only inlet thereto and being suitable for detachably engaging the hub of a hypodermic needle, the improvement comprising a closure cap comprising a substantially rigid body section having an axial plug extending outwardly from the inner surface thereof for forming a sealing engagement with the interior of the said rigid tube and a cylindrical sleeve member spaced outwardly from and concentrically with the said plug also extending from the said inner surface of the body section, the outer end of said body section being provided with a conically tapered lateral surface and a flat outer end surface; whereby the said container is adapted to being inserted into the conically tapered tube holder of a standard centrifuge in an inverted sealed position.

14. A closure cap substantially as in claim 13 wherein the cylindrical sleeve member is provided at the lower end thereof with outwardly extending projections for engaging the said container to retain the said cap on the said rigid tube.

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