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[54] **APPARATUS FOR TAKING SAMPLES OF LIQUID**

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[52] **U.S. Cl.** .....**128/2 F**, 128/DIG. 5, 128/220, 128/276, 128/278

[51] **Int. Cl.** **A61b 5/14**, A61m 1/00

[58] **Field of Search**.....128/2, 214.2, 218, 220, 237, 128/238, 276, 278

[56] **References Cited**

UNITED STATES PATENTS

3,098,482	7/1963	O'Sullivan	128/220
3,348,545	10/1967	Sarnoff et al.	128/218.0
3,378,008	4/1968	Ogle	128/220
3,405,706	10/1968	Cinqualbre	128/2 R

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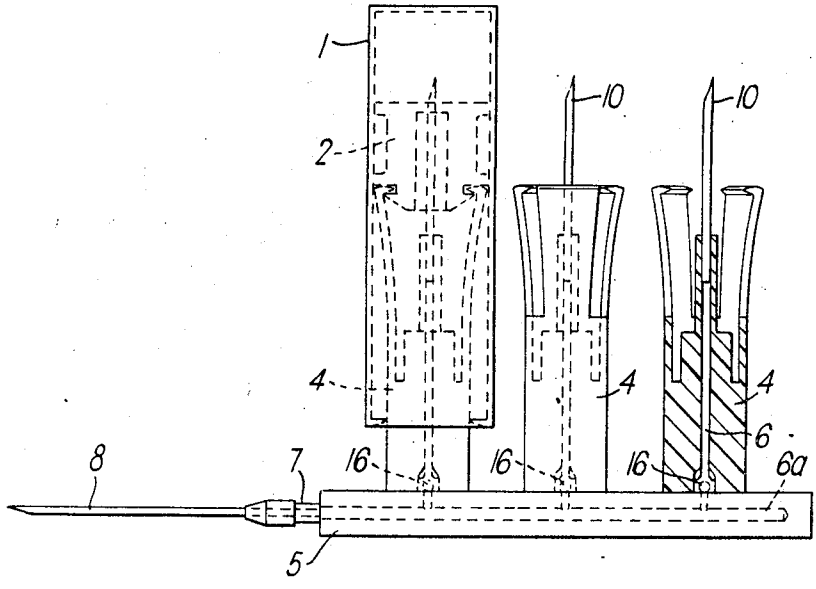
[57] **ABSTRACT**

Suction apparatus for taking samples of liquid such as blood. A receiving tube is provided with an axially slidable piston including a perforable resilient partition, and a support rod, carrying a hollow needle connected to a suction tube, is insertable into the open end of the receiving tube, so that the needle when the support is inserted in the open end perforates the partition and places the space beyond the piston in communication with the suction tube. Interengagement of the support and piston prevents the piston moving relative to the support, when the support is moved relative to the receiving tube. More than one rod may be provided on a common suction duct.

6 Claims, 7 Drawing Figures



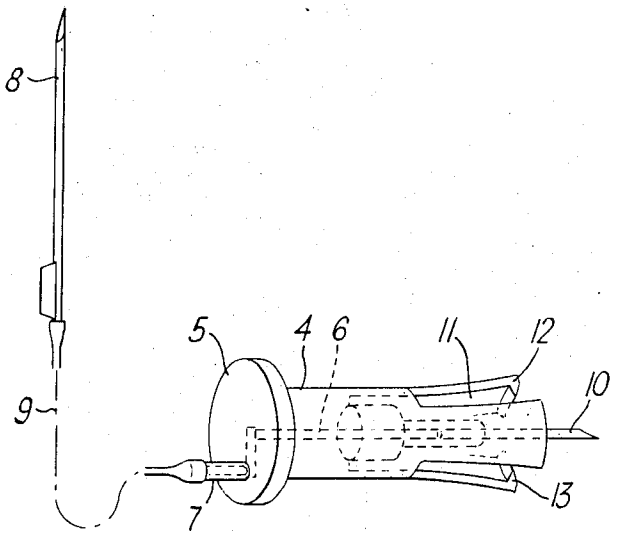


Fig. 1.

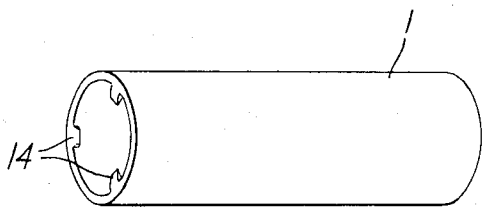


Fig. 2.

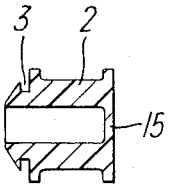


Fig. 3.

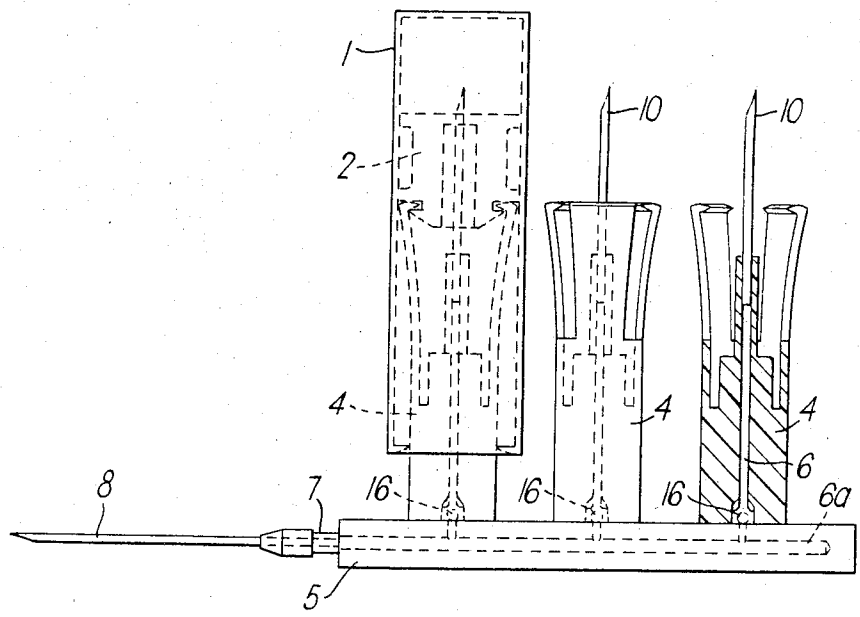


Fig. 4.

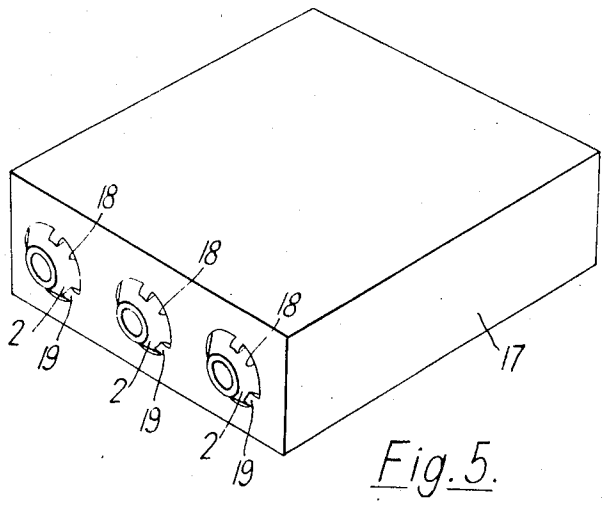


Fig. 5.

FIG. 6

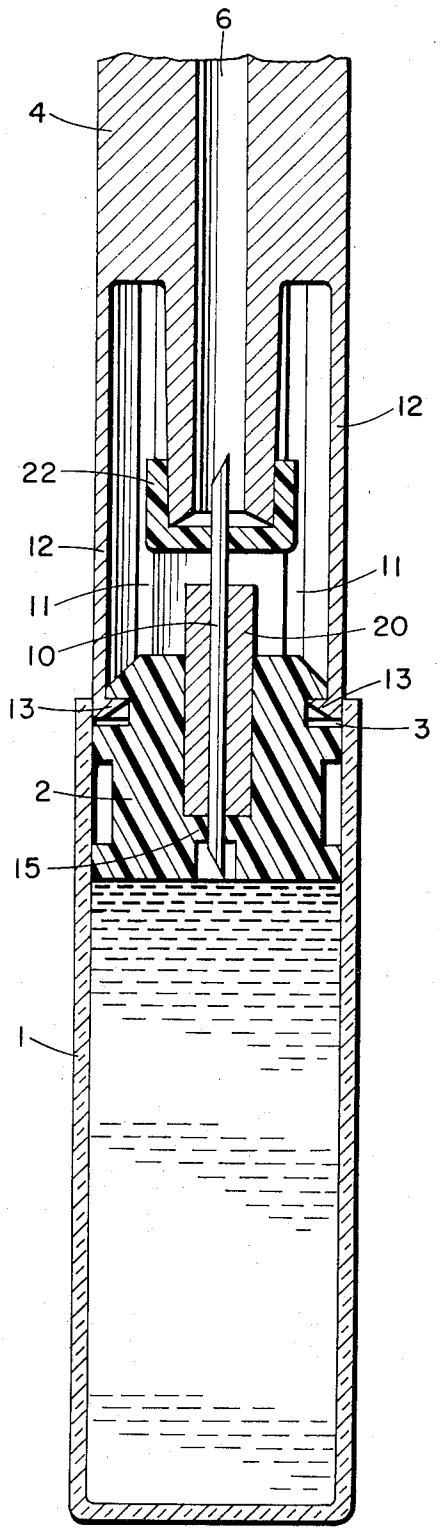
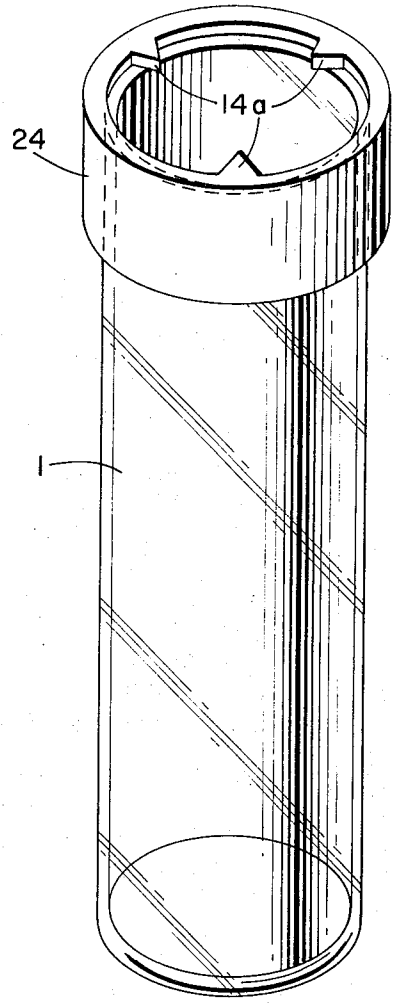


FIG. 7



APPARATUS FOR TAKING SAMPLES OF LIQUID

The present invention relates to apparatus for taking samples of liquid, such as blood.

Blood is taken from human beings for therapeutic or diagnostic purposes, and for the latter purposes analytical laboratories now very often require to be supplied with a number of separate samples, generally from three to five samples, in order to be able to study separately the serum, the plasma and the cellular elements.

The device most commonly employed for taking blood consists of a hollow puncture needle provided with a fin by which it can be gripped and which is connected to a withdrawal tube. The puncture needle is introduced into the patient's vein, generally a vein in the bend of the elbow, and the blood is caused to flow directly into the withdrawal tube under the action of the venous pressure, if necessary increased by the application of a tourniquet. This device is not very suitable for filling a number of tubes, because it is difficult to avoid spilling the blood when changing the tube, since the flow of blood cannot be interrupted.

Blood-taking devices are known in which the puncture needle is mounted on a syringe. It is possible by means of these devices to withdraw the necessary quantities of blood and to distribute them in a number of sampling tubes. These devices must be delicately manipulated and they necessitate the use of both hands, and it sometimes happens that the needle is moved out of the vein or that the latter is pierced through.

In order to obviate these disadvantages, devices have been proposed, which are generally only intended to be used once, and which comprise withdrawal tubes closed by a stopper in which a vacuum has been established. In the taking of blood, the puncture needle is placed in communication with each of the two evacuated tubes, for example by perforating the stopper. The blood immediately fills each of the tubes. However, the maintenance of the vacuum is uncertain and the blood may be modified at the beginning of the taking of the sample by the sudden evacuation or by the throttling consequent upon the vigorous suction through the needle and the withdrawal tube, which may also result in collapse of the vein.

According to the present invention there is provided suction apparatus for taking samples of liquid, such as blood, such apparatus comprising a receiving tube having an open and a closed end, a piston axially slidable in the receiving tube and having a perforable resilient partition, a support rod insertable within the open end of the receiving tube having a suction tube connected thereto, a hollow needle mounted on the support rod and connected to the suction tube and positioned, when the support rod is inserted in the open end of the receiving tube, so as to perforate the partition and place the space between the piston and closed end of the receiving tube, in communication with the suction tube, and interengaging means on the support rod and piston to locate the piston relative to the support rod, when the latter is inserted within the open end of the receiving tube.

Such apparatus is simple and is suitable for single use, it is convenient to handle and is suitable for taking one or more separate samples of liquid, notably of blood, successively or simultaneously, and does not exert any violent action on the liquid sample.

In order that the invention may be more readily understood, the following description is given, merely by way of example, reference being made to the accompanying drawings, in which

FIG. 1 is a perspective view of the support of one embodiment of apparatus according to the invention;

FIG. 2 is a view similar to FIG. 1 of the receiving tube for co-operating with the support rod of FIG. 1;

FIG. 3 is a sectional view of the piston which is slidable in the receiving tube;

FIG. 4 is an elevation, partly in section, of a modified form of apparatus; and

FIG. 5 is a perspective view of a box holding the receiving tubes to co-operate with the support rods of the apparatus of FIG. 4.

FIG. 6 is a fragmentary longitudinal section of an embodiment of the invention showing the support and receiving tube assembled together; and

FIG. 7 is a perspective view of a modified form of the receiving tube.

The apparatus illustrated in FIGS. 1, 2 and 3 is composed of a cylindrical receiving tube 1 having a flat or rounded closed end. The receiving tube 1 contains a piston 2 which closes the tube in fluid-tight manner and is adapted to slide with gentle friction along almost the whole length of the tube. The piston 2 is provided with a perforable resilient partition 15, and its forward face is formed with a circular groove 3, the piston being disposed in the receiving tube with its forward face directed towards the open end of the receiving tube. In use, the receiving tube, thus provided with the piston, is fitted on to a substantially cylindrical support in the form of a support rod 4 of approximately the same length as the receiving tube. To facilitate handling, the support is provided with a base 5. Extending through the support is a duct 6 which passes through the base and is connected by means of an appropriate end member 7 to a suction tube 9, which, as illustrated, is connected to a puncture needle 8. The duct 6 receives at its opposite end a hollow needle 10 capable of perforating the partition 15 of the piston. The support 4 is hollow over a portion between one-quarter and nine-tenths of its total height and preferably between one-third and two-thirds of its total height.

The lateral wall thus freed is formed with one or more slots 11; two to five longitudinal slots are suitable, but it is preferred to provide three slots, as shown. Axially extending arms 12 thus formed in the wall of the support are flared at their ends, which may be done, for example, by pulling them laterally outwards beyond their elastic limit so that they remain deformed.

At their ends, the arm 12 are formed with an internal rib 13, the upper edge of which is frusto-conical and the dimensions of which are such as to enable it to interengage with the circular groove 3 in the piston 2. The ribs thus constitute jaws which can engage the piston and locate it with respect to the support at any position in the receiving tube.

The hollow needle 10 is secured along the axis of the support and is disposed between the jaws in such manner as to enable it to pierce the resilient partition of the piston. The end member 7 may be disposed parallel to the axis of the support 4, but it is generally laterally fixed on the base 5.

Disposed at the open end of the receiving tube are three inwardly projecting lugs 14 to prevent the piston

from leaving the tube. The lugs are generally equal in number to the slots **11** and are distributed in the same manner so that they may move within the said slots. The lugs are so profiled that the piston can readily be introduced into the receiving tube and retained therein.

In operation, before the sample is taken, the receiving tube provided with the piston is fitted on to the support, the piston being maintained partly within the receiving tube by the ends of the jaws **12**. At the time of use, the operator pushes the tube on to its support until the piston abuts the closed end of the tube, the effect of which is to force the hollow needle **10** through the piston so that it pierces the partition **15** and engages the jaws in the groove **3**. Any air remaining at the bottom of the receiving tube is thus expelled through the duct **6**.

The apparatus is then ready to take the sample. In the case of the taking of blood, the operator introduces the puncture needle into the patient's vein and then slowly withdraws the receiving tube from the support. Since the piston is located with respect to the support by the jaws, it slides along the receiving tube towards its open end, whereby the blood is sucked into the space defined between the closed end of the tube and the piston, thus gradually freed, as in a syringe.

When the piston reaches the open end of the receiving tube, the jaws which have until then been maintained slightly compressed within the receiving tube by its lateral walls are freed and, in expanding, move apart and out of the groove in the piston. Since the latter is no longer pulled by the support, it remains at the end of the receiving tube, which is thereby maintained closed in fluid-tight manner. The piston then performs the function of a plug, since the needle **10**, which is fixed to the support has simultaneously been withdrawn from the piston and the hole which it made therein is reclosed on itself. The lugs cause the piston to remain within the receiving tube despite any faulty manipulation. The receiving tube, thus filled with blood and closed in fluid-tight manner, is then immediately available to the analytical laboratory, where either it is directly placed in a centrifuge or any withdrawal needle of known type may be fitted thereto.

It is particularly desirable to be able to employ the piston sliding within the receiver first as the piston of a syringe and then as a plug which is automatically positioned, without the operator having to change his action. Owing to this particular feature, this apparatus is extremely convenient to use.

This apparatus is even more advantageous when a number of separate samples are to be taken. FIG. **4** illustrates a construction of the apparatus according to the invention by means of which three separate samples may be taken.

A puncture needle **8** is, for example, directly fitted without an intermediate flexible tube on to an end member **7** laterally secured to base **5** common to three identical supports **4**. Mounted on each support is a receiving tube provided with its piston as in FIG. **2** and **3**. A common duct **6***a* connects the puncture needle to each of the receiving tubes. It will be appreciated that such a device can be particularly readily employed since when the needle has been introduced into the patient's vein, the operator, holding the withdrawal device at its base in one hand, has only to withdraw by the other hand, either successively or simultaneously as desired, the three receiving tubes which are automatically stoppered after having been filled.

Advantageously, a detachable member, for example a jack, is provided for the simultaneous withdrawal of the receiving tubes.

Of course, modifications may be made to this device. For example in FIG. **6**, a hollow needle **10** pointed at both ends may be secured to an end member **20** which is force-fitted on the piston. The hollow needle thus permits of drawing samples into the interior of the receiving tube. A second resilient partition **22** then closes the end of the duct **6** of the support **4**. With this arrangement, a number of samples can be successively taken without any escape of blood. Also, the lugs may be provided, not directly on the receiving tube, but on a member independent of the tube, for example on a ring **24** fitted around the receiving tube at its open end as shown in FIG. **7**. If the receiving tube is intended to be used only once, the member provided with lugs may be reused. The suction tube may be employed directly or it may be connected to a probe, or to a puncture needle. Any desired number of receiving tubes may be arranged in parallel, this number generally being limited to five. The ducts may be provided, as illustrated, with non-return ball valves **16**, notably in the case where a number of samples are successively taken. The simultaneous handling of a number of receiving tubes may be facilitated by appropriate means, for example by disposing a set of receiving tubes in a closed protective box. Such a box is illustrated in FIG. **5** and it can be seen that the forward face **17** is formed with orifices **18** provided with lugs **19** corresponding to the lugs **14** illustrated in FIG. **2**. The rear face (not shown) may be unlocked and open only at the analytical laboratory. Such a box, on which any information necessary for the identification of the tubes may be inscribed, ensures perfect safety of manipulation and avoids any error. It is also possible to modify the means for gripping the piston and the shape of the piston, the support or various component elements of the device according to the invention.

As materials, one may use more particularly inert and resilient synthetic materials. Thus, by way of non-limiting example, polyethylene, polystyrene and methyl polymethacrylate are suitable. It is convenient to employ a transparent material, because the filling of the receiving tube can then be readily checked. The piston may consist of rubber or any other appropriate elastomer. The needles preferably consist of stainless steel.

The simple construction of the apparatus according to the invention renders possible an economical use even if it is used only once, which is generally the case.

An appropriate reactant, for example a few drops of sodium citrate or heparin solution, may readily be previously introduced into receiving tubes. The reactant may also be introduced in the form of granules into the duct **6** upstream of the piston. The blood dissolves these granules before entering the receiving tube and a homogeneous specimen is thus obtained without any agitation being necessary. The apparatus according to the invention is particularly easy for use, whereby any clumsiness on the part of the operator is avoided. The operator may himself adjust the speed of withdrawal of

the blood to the desired value for avoiding any violent action on the blood.

The apparatus according to the invention is preferably suitable for taking specimens of very varied liquids. This apparatus, previously filled, may also be employed as a distributor, for example for making injections or as a drop counter, notably when the withdrawn liquid is to undergo titrations or analyses by the drop method. It makes it possible, notably, to transfer predetermined volumes of liquids without withdrawing the plug, the latter again acting as a piston after having been perforated by the transfer pipette.

I claim:

1. A suction apparatus for sampling blood or other liquids comprising a liquid receiving tube having an open end and a closed end, a piston having a reduced diameter forward face slidably disposed in the tube with its forward face directed toward the open end of said receiving tube, said piston having an annular groove thereabout adjacent the forward face and a perforable wall, and a support rod slidably disposed in the tube having a duct extending therethrough, a hollow needle disposed between the rod and piston adapted to perforate the said wall of the piston and connect said duct with a space between the piston and closed end of the tube, a plurality of spaced resilient arms defining slots between said arms and carried by the rod about the said needle and pressed inwardly by the wall of the tube combining to form a jaw which grasps the said groove of the piston whereby said piston is held thereby during relative movement between the tube and rod, said tube having restraining means extending into said slots to prevent complete removal of said piston from said tube, said resilient arms spontaneously springing apart from the groove upon their exit from the open end of the tube thereby releasing the piston from their grasp.

2. The apparatus of claim 1 wherein said restraining means is at least two inwardly directed lugs aligned with a slot between resilient arms which partially closes the said open end to prevent the piston from passing therethrough.

3. A plurality of the tube and rod assemblies of claim 1 combined with a means for supplying liquid comprising a single conduit connected to all of the ducts of the said rods.

4. The apparatus of claim 1 wherein the said hollow perforating needle is carried by the rod.

5. The apparatus of claim 1 wherein the said perforating needle is carried by the piston.

6. The apparatus of claim 5 wherein the supporting rod carries a perforable member closing the duct therethrough, the hollow perforating needle is carried by the piston and is pointed at each end, one end disposed to perforate the perforable wall of the piston and the other end disposed to perforate the said perforable member carried by the supporting rod.

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