United States Patent

[11] 3,633,566

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[21] Appl. No. **824,977**
[22] Filed **May 15, 1969**
[45] Patented **Jan. 11, 1972**
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[54] **BLOOD COLLECTING METHOD AND DEVICE**
12 Claims, 13 Drawing Figs.

[52] **U.S. Cl.** **128/2,** 128/276
[51] **Int. Cl.** **A61b 5/10**
[50] **Field of Search** ..... 128/2, 276, 272, DIG. 5, 218

[56] **References Cited**

UNITED STATES PATENTS

3,528,404	9/1970	Chan	128/2
3,405,706	10/1968	Cingualbre	128/2

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Attorney—Hood, Gust, Irish, Lundy & Coffey

ABSTRACT: A blood specimen collecting device comprising means for holding conventional evacuated test tubes, each such tube being sealed with a conventional rubberlike stopper, hollow needle means for penetrating through such stoppers and into such tubes, a vein-puncturing hollow needle, and flexible tube means for connecting the needle means to the vein-puncturing needle. The means for holding the tubes is arranged so that the stoppers face the needle means, and drive means is arranged to provide relative reciprocation between the needle means and the tube holding means to cause the needle means to penetrate through such stoppers. In many cases, such tubes contain materials, such as preservatives, coagulants and anticoagulants, with which the blood must be thoroughly mixed promptly after or immediately as soon as it is withdrawn from the vein. Thus, the device includes means for gently oscillating such tubes while blood is being drawn therein.

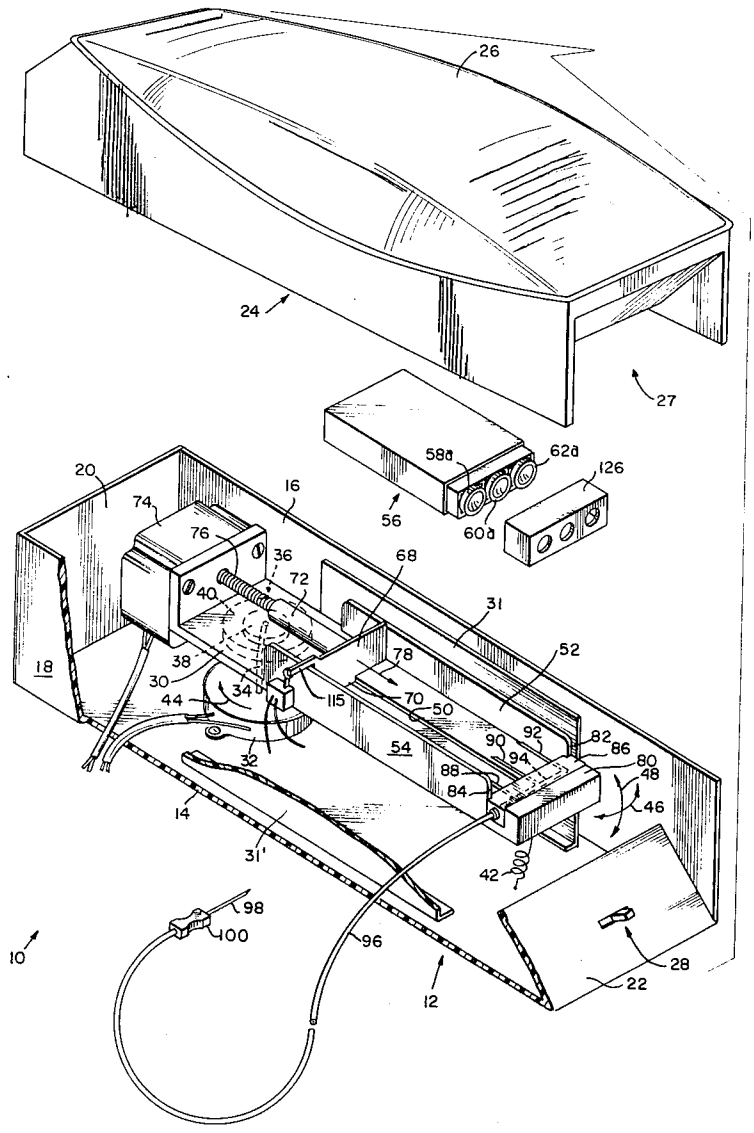

Fig. 1

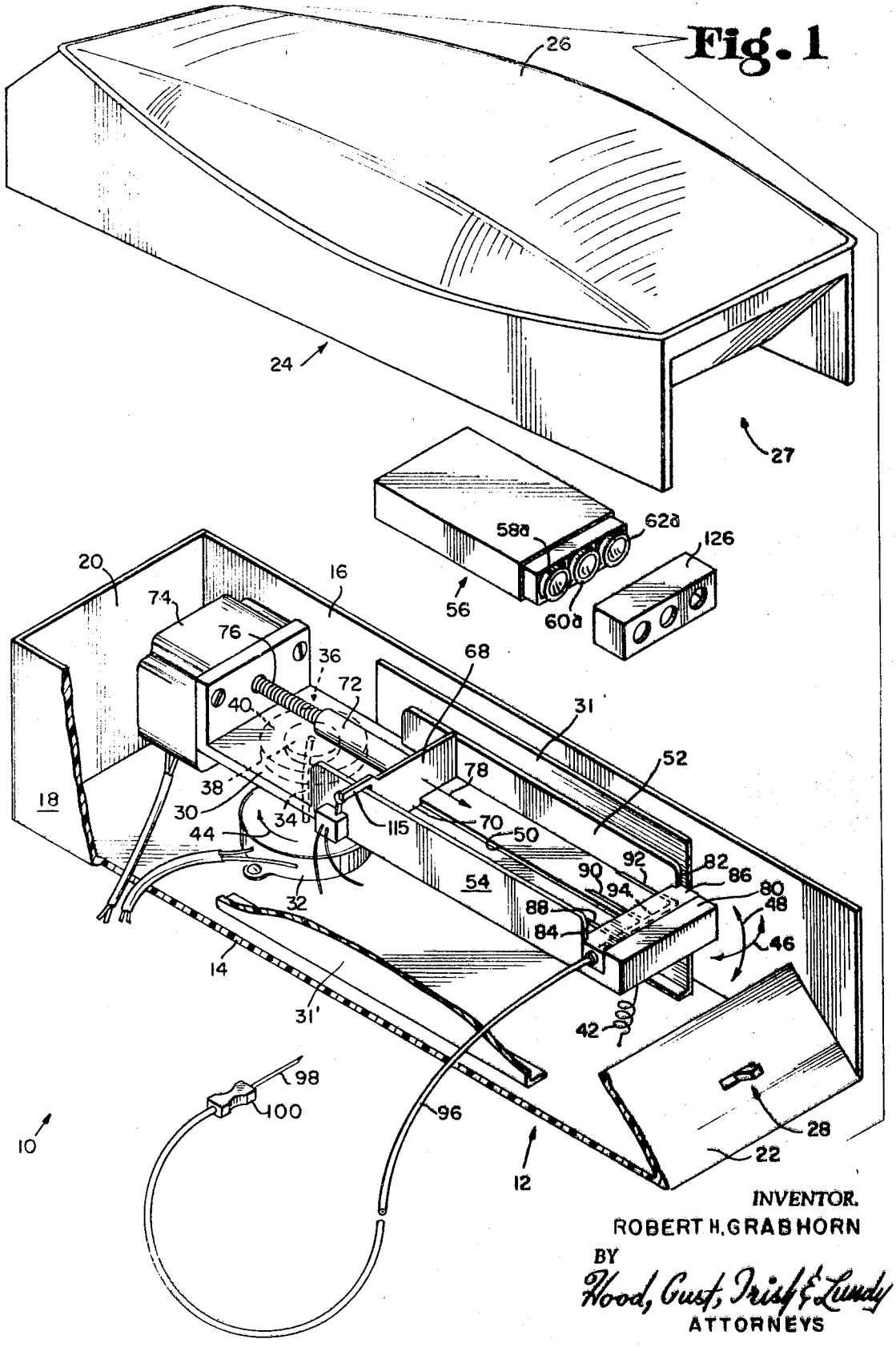

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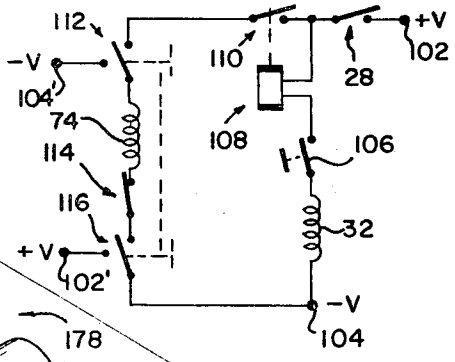
Fig. 1a



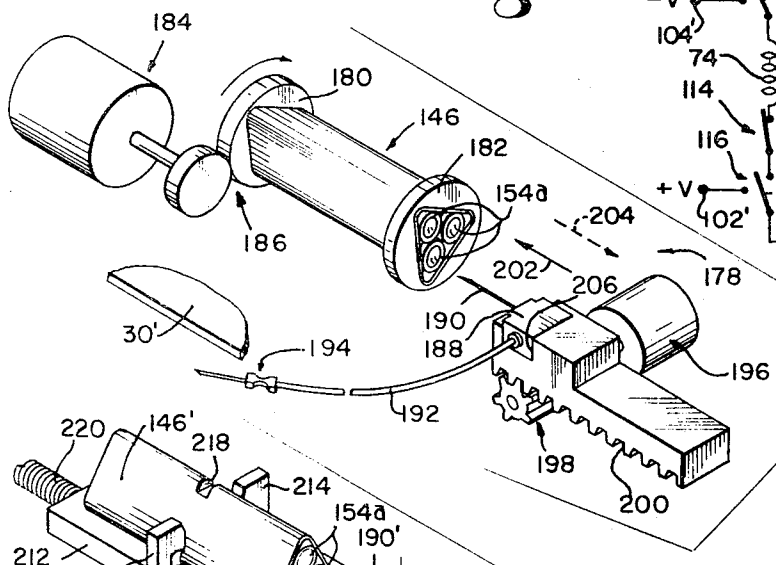


Fig. 5

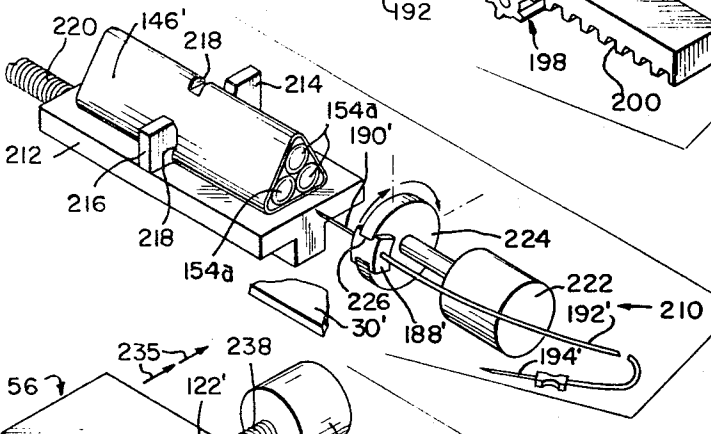


Fig. 6

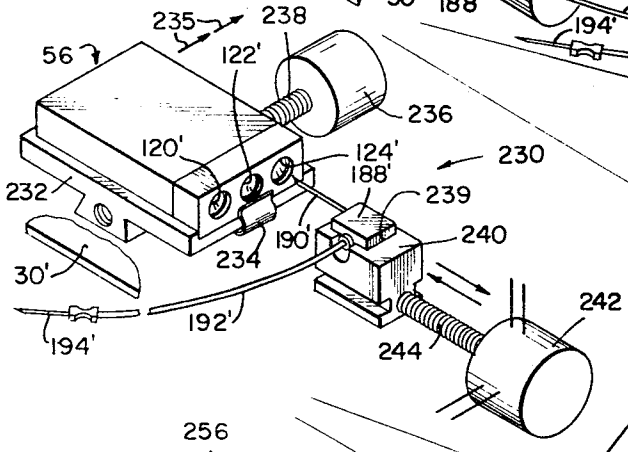


Fig. 7

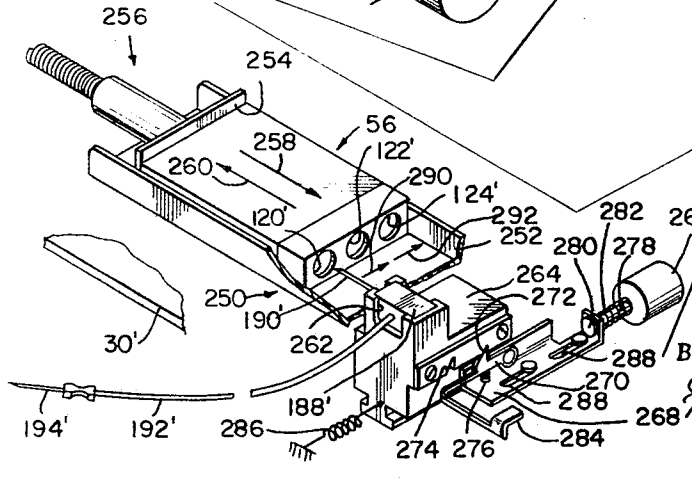


Fig. 8

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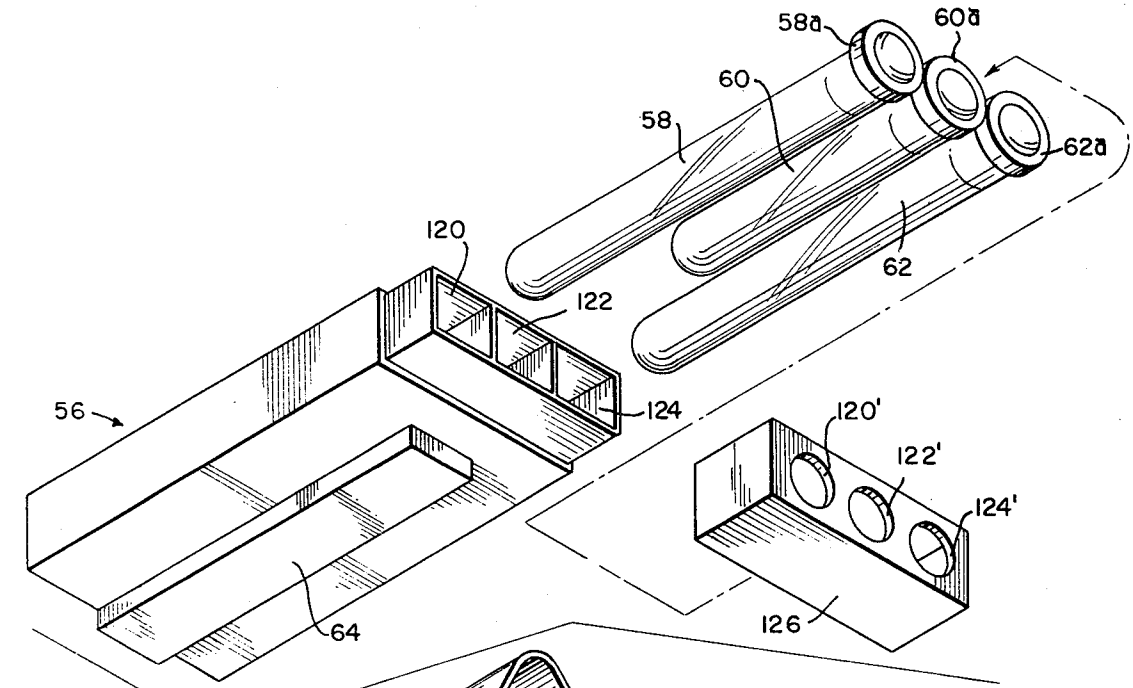

Fig. 2

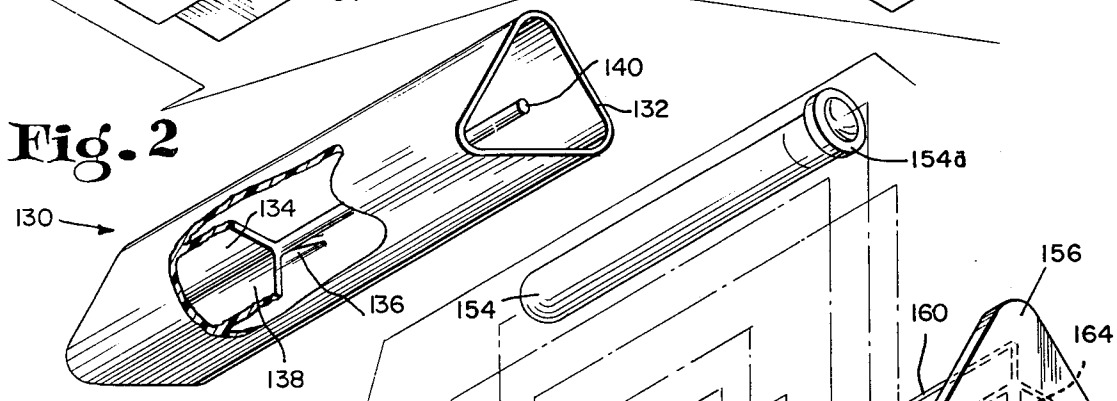

Fig. 3

Fig. 4

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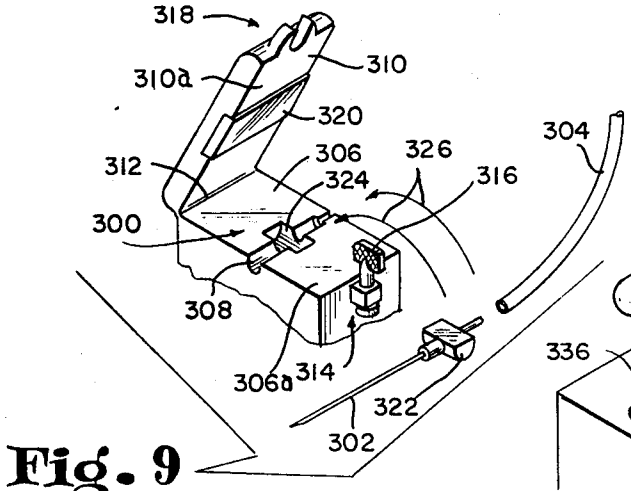

Fig. 9

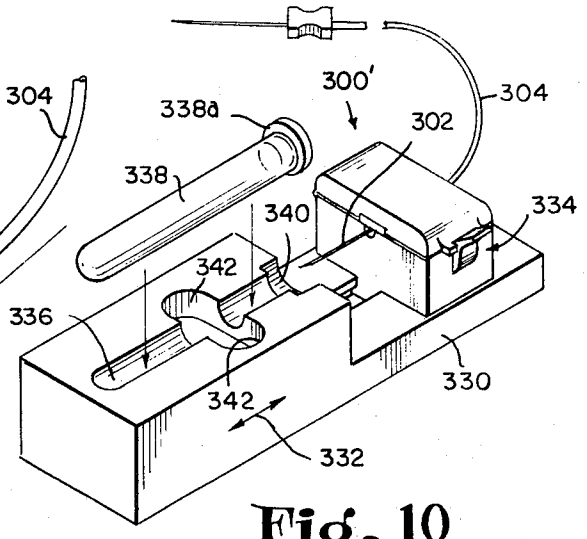

Fig. 10

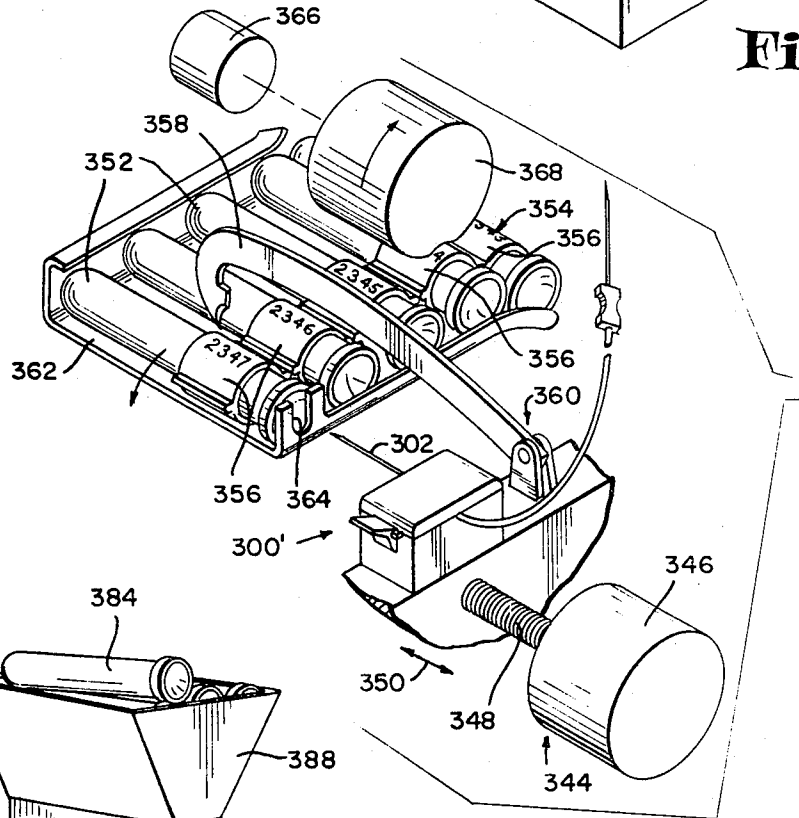

Fig. 11

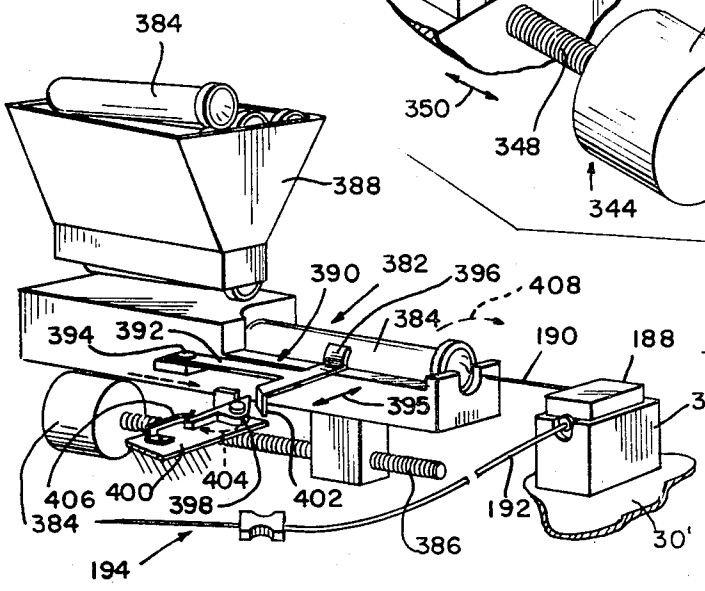

Fig. 12

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BLOOD COLLECTING METHOD AND DEVICE

My invention relates to the collection of blood specimens, and more particularly to the provision of a device for collecting blood specimens from a person's vein, which specimens are usable for testing the blood. My invention does not relate to the taking of blood for use in transfusions.

My device is designed for use with conventional evacuated blood test tubes, each of which is sealed with a conventional rubber or rubberlike sealing stopper. The use of such conventional evacuated test tubes for collecting blood specimens is well known. Specifically, it is common practice to take several blood specimens from a person by sticking the forward end of a double-ended hollow needle into one of the person's veins and then sequentially pushing the rear end of the needle into and through the sealing stoppers of the requisite number of tubes. While this practice is widely used, it suffers from several disadvantages. First of all, the forward end of the double-ended needle is left in the person's vein during the entire process while the requisite number of tubes are at least partially filled with blood. This means that the stoppers of such tubes must be pushed onto and pulled from the rear end of the double-ended needle while the forward end of the needle is extending into the vein. An inexperienced nurse or technician may accidentally shift the forward end of the needle seriously to damage the vein wall, In fact even an experienced nurse or technician may damage the vein with the forward end of the needle if the person from whom the blood specimens are being taken jerks or moves suddenly. Further, as will be discussed hereinafter, conventional devices do not facilitate proper agitation of the blood specimens.

My apparatus is constructed so that several of such tubes can be either simultaneously or sequentially filled without, in any way, manipulating or moving the needle which punctures and extends into the vein. Specifically, it is my concept to provide a vein-puncturing needle which is connected by means of a flexible tube to means for admitting the blood to the evacuated tubes.

Thus, my blood specimen collecting device, broadly speaking, comprises means for holding conventional evacuated test tubes, each of which is sealed with a conventional stopper, hollow needle means for penetrating through such stoppers and into such tubes, a vein-puncturing hollow needle, and flexible tube means for connecting the needle means to the vein-puncturing needle. The tube holding means of my device is arranged so that the stoppers of the tubes face the needle means. I provide drive means for producing relative reciprocation between the needle means and the tube holding means to cause the needle means to penetrate through such stoppers.

I have constructed my device in such a manner that the several tubes into which the blood is to be deposited and the needle means for puncturing through the stoppers of the tubes may be out of the sight of the person from whom the blood is to be taken. I prefer to use an electrically operated drive means for causing the needle means to penetrate through the stoppers so that a technician may merely insert the vein-puncturing needle into the vein and then operate a switch to cause the needle means to penetrate through the stoppers.

In one embodiment of my invention, the needle means for penetrating the stopper includes a single hollow needle which is connected by the flexible tube means to the vein-puncturing needle, and this single needle is sequentially penetrated through the stoppers of the desired number of tubes. In another embodiment of my invention, the needle means includes a plurality of hollow needles, each of which is connected to the vein-puncturing needle by the flexible tube means. In this embodiment, my drive means is arranged simultaneously to penetrate each of the hollow needles of the needle means through, respectively, the stoppers of the tubes.

One preferred embodiment of my invention is a device which is constructed within a small casing the upper surface of which provides a padded resting place for the arm of the person from whom blood is to be taken. My device can be placed by a seat in a doctor's office or in a laboratory and it can be stylishly decorated so as not to appear to be a clinical instrument. When a person sits in the seat and places an arm upon the padded surface of my device, the nurse or technician can pull the vein-puncturing needle from a small opening in the side of the device, remove the conventional protective covering from the needle, insert the forward end of the needle into the vein of the arm and then quickly operate the switch which operates the drive means of the device. The person from whom the blood is drawn does not have to see and preferably cannot seen the tubes into which the blood is drawn. In fact, preferably, the person can only see the needle which extends into the vein and a small portion of the flexible tubing leading away from this needle.

In many cases, the evacuated tubes into which the blood is drawn contain materials, such as preservatives, coagulants and anticoagulants, with which the blood must be thoroughly mixed promptly after or immediately as soon as it is withdrawn from the vein. It is well known that, if the blood is not properly mixed with this material, which is usually in powder form, the tests made on the blood may, at best, be inconclusive. Technicians and nurses who take blood specimens are instructed gently to oscillate each evacuated tube after its stopper is pulled off of the rear end of the needle which is extending into the vein. This is, of course, a manual operation which lengthens the process of taking the blood.

The function of gently oscillating the tube for a significant period of time properly to mix the blood with the material contained in the tube cannot be overly emphasized. If the blood is not agitated sufficiently to cause it to mix with the material in the tube, the tests on the blood may be totally inconclusive. If the blood is overly agitated, the blood cells may be damaged to the point where the tests on the blood will be inconclusive. Further, if the blood is not mixed properly with the material in the tube promptly after or, in some cases, immediately as soon as it is drawn into the tube, the tests on the blood may be inconclusive.

In an attempt to obtain proper mixing of the blood with the material disposed in the tube into which the blood is drawn, nurses and technicians are often instructed gently to oscillate the tube after the blood is drawn therein to cause the "bubble" in the tube to move from end to end of the tube a specific number of times without breaking or separating. In other words, when blood is drawn into an evacuated tube, there is left a "bubble" which is analogous to the "bubble" of a conventional "bubble level. " If this "bubble" in the blood test tube is overly agitated, it will break up into several small segments.

In order to assure that the blood will be immediately and properly mixed with the materials in the tubes into which the blood is drawn, my blood collecting device includes means for continuously and gently oscillating the tubes while the blood is drawn therein and for a predetermined and desired period thereafter. In one preferred embodiment of my device, the drive means which causes the needle means to penetrate the stoppers of the tubes cannot be energized until the means for continuously and gently oscillating the tubes is energized.

Other objects and features of my invention will become apparent as this description progresses.

To the accomplishment of the above and related objects, my invention may be embodied in the forms illustrated in the accompanying drawings and the method described herein, attention being called to the fact, however, that the drawings and description are merely illustrative and that changes may be made in the specific constructions illustrated and described and in the methods described, so long as the scope of the appended claims is not violated.

In the drawings:

FIG. 1 is an exploded, perspective view, partially sectioned, showing one embodiment of my invention;

FIG. 1*a* is a schematic showing the type of controls which may be used with the embodiment of FIG. 1;

FIG. 2 is an exploded, perspective view showing a cartridge means for holding a plurality of conventional evacuated test tubes, which cartridge means is usable with the embodiment of FIG. 1 as well as other embodiments of my invention;

FIG. 3 is a perspective view, partially sectioned, of a generally triangularly shaped cartridge means for holding evacuated test tubes;

FIG. 4 is an exploded, perspective view showing a generally triangularly shaped cartridge for holding the test tubes and the needle means for penetrating through the stoppers of the test tubes;

FIG. 5 is a somewhat diagrammatical view showing a single hollow needle for penetrating through the stoppers of a plurality of tubes held in a generally triangularly shaped cartridge, indexing means for sequentially positioning the stopper of each tube adjacent the single needle and drive means for driving the needle through the stoppers;

FIG. 6 is another somewhat diagrammatical view showing a generally triangularly shaped cartridge holding three such evacuated tubes, a single needle for penetrating through the stoppers of the tubes, indexing means for sequentially moving the needle into position adjacent each of the stoppers, and means for driving the stoppers onto the needle;

FIG. 7 is another somewhat diagrammatical view showing a cartridge, such as in FIG. 2, indexing means for moving the cartridge in a step-by-step manner past a single needle and drive means for penetrating the needle sequentially through each of the stoppers;

FIG. 8 is another somewhat diagrammatical view showing a cartridge, such as in FIG. 2, a single needle, indexing means for moving the needle in a step-by-step manner sequentially to position the needle adjacent each of the stoppers and drive means for driving the stoppers onto the needle;

FIG. 9 is a fragmentary, perspective view showing a chuck or chuck means for releasably and rigidly holding a hollow needle which is used to penetrate through a tube stopper;

FIG. 10 shows a chuck means for holding a needle, means for holding a tube so that its stopper faces the needle and means mounting the chuck means for reciprocation toward and away from the stopper;

FIG. 11 is still another somewhat diagrammatical view showing a chuck means for holding a needle which penetrates through stoppers of tubes, a cartridge belt carrying a plurality of such tubes, indexing means for advancing the cartridge belt, means for driving the needle through the stoppers and means for separating each loop of the belt to provide discrete tubes; and

FIG. 12 is a further diagrammatical view showing cartridge means for holding a plurality of tubes, a single needle and drive means for picking a tube from the cartridge means and driving its stopper onto the needle.

Referring now to the drawings, and particularly to FIGS. 1 and 2, it will be seen that I have illustrated my device **10** as comprising a housing **12** having a bottom wall **14**, sidewalls **16, 18**, end walls **20, 22** and a cover **24** which fits down over the sidewalls. The cover **24** is provided with an upwardly facing, padded surface **26** upon which a person may comfortably rest an arm. As illustrated, the cover may be cut away or formed as indicated at **27** and the end wall **22** may be inclined upwardly and inwardly to provide a cavity in which a conventional electric switch **28** is located. The purpose of this switch will be discussed in detail hereinafter.

It will be appreciated that the device **10** may be as decorative as desired. The housing **12**, including the cover **24**, may be constructed from any suitable material, such as metal or plastic. The total length of the device **10** need not be much greater than the length of a person's forearm. The width of the device may be, for instance, 6 inches.

While I have illustrated the cover **24** as being arranged to slip down over the end wall **20** and sidewalls **16, 18**, it will be appreciated that the cover may be hingedly mounted in a conventional manner to swing upwardly.

Inside the housing **12**, I provide an elongated platform **30** which my be gently oscillated by means of a conventional electric motor **32**. In the illustrative embodiment, the motor **32** is mounted on the bottom **14** and its output shaft **34**, which is bent is illustrated, extends upwardly therefrom. The platform **30** may be connected to the bent shaft **34** by means such as illustrated bearing **36**, the inner race **38** of which is mounted on the upper end of the bent shaft and the outer race **40** of which is connected to the platform. I may provide means such as the illustrated spring means **42** extending between portions of the housing **12** and the platform **30** yieldably to hold the platform **30** in position. Further, I may provide means, such as the illustrated walls **31, 31'** for confining the movement of the platform. Thus, because of the bend in the shaft **34**, when the motor **32** is energized to drive the shaft in the direction of the arrow **44**, the platform **30** is oscillated in all directions as indicated by the arrows **46, 48**. I prefer that the motor **32** be a relatively low-speed motor so that this oscillation of the platform **30** will be gentle and smooth. The reason for gently oscillating the platform **30** is to mix thoroughly the blood drawn into the test tubes with the materials contained therein.

The platform **30** provides a longitudinally extending, square-walled trackway **50** and a pair of longitudinally and vertically extending sidewalls **52, 54**, the sidewalls and the trackway providing a guideway for receiving a cartridge **56** (FIGS. 1 and 2) containing, in the illustrative embodiment, three evacuated blood test tubes **58, 60, 62**, each of which is sealed with a conventional rubberlike stopper **58***a*, **60***a*, **62***a*. As illustrated in FIG. 2, the cartridge **56** may be provided with a guide strip **64** which is slidably received in the trackway **50** to guide the cartridge for movement along the platform **30**.

I provide a pusher plate **68** which is arranged for reciprocation in the guideway provided by sidewalls **52, 54**, the pusher plate being provided with a downwardly extending tang **70** which slidably engages the trackway **50**. An internally threaded tube **72** extends rearwardly from the pusher plate **68** as illustrated. In order to drive the pusher plate **68**, I provide a motor **74** which is mounted on the rear end of the platform **30** as illustrated, the motor **74** driving an externally threaded shaft **76** which threadedly engages the tube **72**. Thus, when the motor **74** is energized to drive the shaft **76** in one direction, the pusher plate **68** moves in the direction of the arrow **78** and, when the motor **74** is energized to drive the shaft **76** in the opposite direction, the pusher plate **68** moves in the opposite direction.

There is an end member **80** at the forward end of the platform **30**, this member being spaced apart from the forward ends **82, 84** of the guide walls **52, 54**. In this space between the member **80** and the ends **82, 84** of the walls **52, 54**, I can drop a manifold **86** from which extends three parallel and equally spaced apart hollow needles **88, 90, 92**. The manifold **86** is formed with an internal passageway **94** which is in communication with the needles **88, 90, 92**. A flexible plastic tube **96**, preferably made from a hemorepellant material, connects the passageway **94** and, therefore, the needles **88, 90, 92**, to a vein-puncturing needle **98**. I prefer to provide a gripper **100** on the vein-puncturing needle **98** as illustrated.

In the illustrative embodiments, each end of the manifold **86** is provided with a corner notch for receiving the end **82, 84** of the adjacent wall **52, 54**. This is one scheme for holding the manifold **86** in a desired position relative to the platform **30**.

In operation of the device **10**, the nurse or technician responsible for taking blood specimens will remove the manifold **86** including the needles **88, 90, 92** from a sanitary package and place the manifold in its illustrated position on the platform **30**. Then, the nurse or technician will drop a cartridge **56** into the guideway provided by the trackway **50** and the sidewalls **52, 54** with the stoppers **58***a*, **60***a*, **62***a* facing the needles **88, 90, 92**. Preferably, as will be appreciated by those familiar with the use of evacuated test tubes, each of the needles **88, 90, 92** is coaxially aligned with the stopper **58***a*, **60***a*, **62***a* through which the needle will penetrate. With the cartridge **56** and the manifold **86** in position, the nurse or technician will energize the motor **32** gently to oscillate the platform **30**. Then, after the vein-puncturing needle **98** is inserted into a vein, the motor **74** may be energized to drive the pusher plate **68** in the direction of the arrow **78** to cause the needles **88, 90, 92** to penetrate through, respectively, the stoppers **58***a*, **60***a*,

Referring now to FIG. 5, it will be seen that I have illustrated one device, indicated generally at **178**, for sequentially depositing blood specimens into a plurality of tubes carried in a cartridge **146**, The device **178** includes members **180**, **182** for supporting the cartridge **146** for rotation about a journal axis extending parallel to the axes of the tubes carried in the cartridge and equidistantly spaced therefrom. It will be seen that, in the illustrative embodiment, each of the support members **180**, **182** is provided with a triangularly shaped cutout for receiving and engaging an end portion of the cartridge **146**. I have illustrated a rotary stepping drive motor **184** which is drivingly connected, by means indicated at **186**, to the support member **180**. This motor **184**, when energized, is arranged to drive the member **180** and the cartridge **146** through 120° step movements about the axis defined by the members **180**, **182**. The means by which the members **180**, **182** are mounted as well as the motor **184** and the transmission **186** may be conventional and need not be discussed, in detail, in this description.

The device **178** further comprises a block or a single channel manifold **188** which carries a single hollow needle **190** which is connected through a passageway in the block and a flexible tube **192** to a vein-puncturing needle **194**. The block **188** may be a plastic block formed with the passageway providing communication between the needle **190** and the tube **192** in the same manner that the manifold **86** is formed. The needle **190** is preferably held so that it will extend toward the stoppers **154***a* sealing the tubes carried in the cartridge **146**. Specifically, it is desirable that the needle **190** always be coaxially aligned with one of the tubes in the cartridge **146** carried by the support members **180**, **182**.

In order to drive the needle **190** sequentially to penetrate through the stopper **154***a*, I provide a drive motor **196** which may be drivingly connected to the block **188** by means such as the illustrated gear **198** and rack **200**. Specifically, the block **188** is carried by the rack **200** and, when the motor **196** is driven in one direction, the needle **190** moves in the direction of the arrow **202** and, when the motor is driven the opposite direction, the needle **190** moves in the direction of the arrow **204**.

Preferably, the motor **184**, **196**, rack **200** and supports **180**, **182** are mounted upon an oscillable platform **30'**, only a fragment of which is shown.

Thus, in the use of the device **178**, the nurse or technician taking the blood specimens will place the cartridge **146** in the support members **180**, **182**, place the block **188** in the proportioned cutout **206** in the rack **200** and, then, place the needle **194** into a vein. At that point, the motor for oscillating the platform **30** is energized and then the motor **196** is energized to move the needle **190** in the direction of the arrow **202** to penetrate the needle through the coaxially aligned stopper **154***a*. After a predetermined time, the motor **196** is again energized to move the needle **190** in the direction of the arrow **204** so that the motor **184** can be energized to rotate the cartridge **146** 120° to place another in coaxial alignment with the needle **190**, and, thereafter, the needle **190** is again moved in the direction of the arrow **202** to deposit blood into the second coaxially aligned tube.

It will be appreciated that I may provide circuit means arranged sequentially to operate the indexing motor **184** and the drive motor **196** so that the nurse or technician taking the blood specimens need only throw one switch after the needle **194** is punctured into a vein. Preferably, during the entire blood-drawing operation, the platform **30'** is being gently oscillated to oscillate the tubes in the cartridge **146**.

The rack **200** constitutes means for rigidly holding the hollow needle **190** and the cartridge **146** comprises means for supporting a plurality of conventional evacuated test tubes. The motor **184** and transmission **186** and support member **180**, **182** comprise indexing means for providing relative movement between the means which supports the needle **190** and the cartridge **146**. The motor **196** and the transmission **198** comprise drive means for providing relative reciprocation between the support means for the needle **190** and the cartridge **146**.

Referring now to FIG. **6**, it will be seen that I have illustrated another device, indicated generally at **210**, for sequentially depositing blood into a plurality of test tubes. This device **210** comprises a support **212** upon which a cartridge **146'** may be placed. In the illustrative embodiment, the support **212** provides a pair of spaced apart locating blocks **214**, **216** which engage notches **218**, formed in the edges of the cartridge **146'** to prevent movement of the cartridge longitudinally, i.e., in the direction of the axes of the tubes in the cartridge, relative to the support **212**. The illustrative support **212** is reciprocated longitudinally by a drivescrew **220** which is driven by a motor not shown.

It will be seen that I have illustrated a manifold or block **188'** and a single hollow needle **190'** and means for sequentially positioning the needle adjacent the stopper **154***a* of each of the tubes in the cartridge **146**. Specifically, in the illustrative embodiment I provide a rotary-stepping motor **222** for moving a support **224** which holds the block **188'** in a step-by-step manner. The motor **222** preferably moves the support **224** in 120° increments.

The cartridge **146** and the support **212** are proportioned and arranged so that one of the tubes in the cartridge **146** will he coaxially aligned with the needle **190'** in each of its three positions obtained by energizing the motor **222**. Thus, the support **224** moves about an axis which is parallel to and equidistantly spaced from the axes of the tubes in the cartridge **146**.

The nurse or technician taking blood specimens using the device **210** places the cartridge **146** on the support **212** as illustrated and then places the block **188'** in the proportioned cutout **226** in the support **224**. Then, after the needle **194'** is inserted into the vein, the nurse or technician may operate a switch to cause the support **212** to be driven toward the needle **190'** to penetrate the needle through the stopper **154***a* of the first tube in the cartridge **146**. After a predetermined time the support **212** is moved away from the needle **190'** and then the motor **222** is energized to index the needle so that is is in coaxial alignment with the second tube in the cartridge **146**.

Again, the support **212**, motor **222** and drivescrew **220** are preferably mounted on an oscillable platform **30'**, only a portion of which is shown.

In the device **178**, the needle **190** is reciprocated axially toward and away from the stoppers of the tubes in the cartridge **146** and the cartridge is rotated about an axis in a step-by-step manner sequentially to position each stopper adjacent the needle. In the device **210**, the tubes and the cartridge are reciprocated toward and away from the needle **190'** and the needle is driven about an axis in a step-by-step manner sequentially to be positioned adjacent each of the stoppers.

Referring now to FIG. **7**, it will be seen that I have illustrated still another device, indicated generally by the reference numeral **230**, for sequentially depositing blood into a plurality of test tubes. The device **230** utilizes the cartridge **56** which contains three tubes as discussed previously. The cartridge **56** is placed upon a support **232** and held in position thereon by means such as the spring clip indicated at **234**. The support **232** and the cartridge **56** supported thereon is moved in a step-by-step manner as indicated by the two arrows **235** by a motor **236**. The motor **236** may be connected to the support **232** by means such as the illustrated drivescrew **238**. The motor **236** is, therefore, indexing means for moving the cartridge **56** in a step-by-step manner sequentially to position the stopper of each tube contained in the cartridge adjacent a single hollow needle **190'**. The block **188'** carrying the needle is placed in a cutout **239** on a support **240** which, in the illustrative embodiment, is drivingly connected to a motor **242** by a drivescrew **244**. The motor **242** is a bidirectional motor used to reciprocate the needle **190'** toward and away from the cartridge **56** sequentially to penetrate the needle **190'** through the stoppers of the tubes contained in the cartridge.

62a. As soon as the needles 88, 90, 92 penetrate through the stoppers 58a, 60a, 62a, blood will be drawn from the vein through the needle 98, tube 96, passageway 94 and into the evacuated tubes 58, 60, 62.

It will be appreciated that the above-described method is such that the only action required by the nurse or the technician after the needle 98 is inserted into the vein and before the needle is withdrawn from the vein is to throw a switch which energizes the motor 74. The tube 96 is of sufficient length to permit the platform 30 to oscillate without, in any way, disturbing the position of the needle in a vein.

Thus, by using my device 10, a plurality of conventional evacuated test tubes, such as the three illustrated tubes 58, 60, 62 can be simultaneously at least partially filled with blood in a short period of time and without maneuvering the needle 98. Since the platform 30 can be oscillated before the needle 98 is inserted into the vein or, at least, before the motor 74 is energized, my device 10 will begin to mix the blood drawn into the tubes 58, 60, 62 immediately with the material in the tubes. In fact, in order to assure such immediate mixing of the blood with the material in the tubes, I prefer to arrange my device 10 so that the motor 74 cannot be energized to drive the pusher plate 68 forward until the motor 32 is energized to oscillate the platform 30. As stated previously, this is an important object of my invention.

While I have illustrated three test tubes 58, 60, 62, it will be appreciated that the cartridge 56 may contain more or less tubes as desired. Generally, in most blood tests, it is only desired that three such tubes be at least partially filled with blood.

Referring now to FIG. 1a, an illustrative control system for my device 10 will be discussed. I show positive voltage terminals 102, 102' and negative voltage terminals 104, 104' providing power for my device 10. It will be appreciated that these terminals may represent the terminals of a battery power source or the output terminals of a conventional rectifier for alternating current. The motor 32 is energized by current flow through a manually operated switch 106, the coil of a relay 108 and the master switch 28. The relay 108, when energized, closes switch 110 through which the motor 74 is energized for rotation in a direction for driving the pusher plate 68 in the direction of the arrow 78. That is, current flows from the terminal 102, through the switch 28, switch 110, a switch 112, the coil of motor 74, a switch 114 and a switch 116 to the negative voltage terminal 104 to drive the motor 74 to move the plate 68 in the direction of the arrow 78.

Switches 112 and 116 are manually operated, double throw switches arranged, when thrown one way and switches 110 and 114 are closed, to drive motor 74 in one direction to advance plate 68 and, when thrown in the opposite way and switch 114 is closed, to drive motor 74 in the opposite direction to retract plate 68. Switch 114 is normally closed and is opened by a tang 115 in the plate 68 when the plate has moved a predetermined distance in the direction of the arrow 78. Switches 112 and 116 may be connected to a common actuator as illustrated.

It will be appreciated that the motor 74 cannot be energized to advance the plate 68 in the direction of the arrow 78 unless the switch 110 is closed and that the switch 110 will not be closed unless the motor 32 is energized to oscillate the platform 30.

Referring now to FIG. 2, it will be seen that the cartridge 56 is provided with three longitudinally extending, parallel openings 120, 122, 124 into which the tubes 58, 60, 62 are, respectively, inserted. The mouths of these openings 120, 122, 124 are proportioned and designed snugly to engage, respectively, the stoppers 58a, 60a, 62a so that, when the cartridge is pushed in the direction of the arrow 78 by the pusher plate 68, the force exerted by the needles 88, 90, 92 upon the stoppers will not be directed through the walls of the tubes 58, 60, 62. The further advantage of having the mouth of the openings 120, 122, 124 snugly engaging the stoppers 58a, 60a, 62a is that not all of the tubes which will be used with the cartridge will be of the same length.

I prefer to provide a cover 126 which slips over the end of the cartridge 56 as illustrated, this cover being provided with openings 120', 122', 124' which are in registry with the mouths of the correspondingly numbered openings in the cartridge. These openings 120', 122', 124' are provided to accommodate the needles 88, 90, 92.

It will be appreciated by those familiar with blood collecting methods that the test tubes 58, 60, 62, after they are at least partially filled with blood, are conventionally inserted into a plastic mailing package. Thus, my cartridge 56, which is usable with the device 10 in the blood-drawing operation, can be used also as a mailing package.

Referring now to FIG. 3, it will be seen that I have illustrated a generally triangularly shaped cartridge 130 having an open end 132 through which three conventional evacuated tubes are inserted. Inside the cartridge, there are three triangularly related wall sections 134, 136, 138 providing cubicles for receiving the closed ends of the tubes which are inserted into the cartridge. A centrally located, longitudinally extending stem 140 is arranged to extend from the intersection of the wall sections 134, 136, 138 to the open end 132 of the cartridge 130. The stem 140 separates the tubes which are inserted into the cartridge 130. The end of this stem 140 which is adjacent the open end 132 is proportioned and designed so that, when three tubes are inserted into the cartridge 130, the stoppers sealing the tubes are engaged snugly by portions of the perimeter of the open end 132 of the cartridge and by the adjacent end of the stem 140.

Referring now to FIG. 4, it will be seen that I have illustrated another generally triangularly shaped cartridge 146 which provides a plurality of openings 148, 150, 152 which receive, respectively, conventional evacuated tubes, such as indicated at 154. The openings 148, 150, 152 are also triangularly arranged so that, when tubes are, respectively, received therein, the axes of the tubes will extend through the corners of an equilateral triangle. The reason for this will become apparent as this description progresses.

For use with the generally triangularly shaped cartridges 130, 146, I provide a generally triangularly shaped manifold 156 from which extends hollow needles 158, 160, 162, the manifold being provided with a passageway 164 in communication with the needles. This passageway 164 is connected by means of a flexible tube 166 to a vein-puncturing needle 168. The needles 158, 160, 162 are triangularly arranged so that each needle can be coaxially aligned with one of the openings 148, 150, 152 to be penetrated through the stopper of the tube disposed in the opening.

Thus, the manifold 156 and either one of the cartridges 130, 146 may be used with my device 10.

For aesthetic reasons, I may provide a paper liner 170 which can be fitted into the open end of the cartridge 146 so that, when the manifold 156 is pulled away from the cartridge, the blood drops on the needles 158, 160, 162 will drop into and be absorbed by the liner 170. Of course, this liner 170, the manifold 156, tube 166 and needle 168 may be conventionally disposed of after the blood is deposited into the tubes carried in the cartridge 146.

The cartridges shown in FIGS. 2, 3 and 4 may be used with my device 10 simultaneously to deposit blood into the tubes disposed in the cartridges. Further, these same cartridges may be used with other embodiments of my invention which sequentially deposit blood into the tubes contained in the cartridge as will be hereinafter described.

The triangularly shaped cartridges 130, 146 may be preferable in some cases because they will stand alone on their bases, i.e., on their closed ends, to provide a self-standing unit with which the laboratory technicians can work. Further, for the same amount of material, a triangularly shaped cartridge may be somewhat stronger than a rectangularly shaped cartridge. Further, as will be discussed in conjunction with FIGS. 5–8, as a matter of mechanics, it may be advisable to index or position the triangularly shaped cartridges 130, 146 about a longitudinal axis.

Again, the support **232**, **240**, **242** and the motor **236** are preferably mounted on an oscillable platform **30'**, only a portion of which is shown.

Referring now to FIG. **8**, it will be seen that I have illustrated still another device **250** comprising a guideway **252** for slidably receiving a cartridge **56** and means **254** for drivingly connecting the cartridge to an illustrative drivescrew arrangement **256**. The drivescrew arrangement is provided for reciprocating the cartridge **56** in the guideway **252** as indicated by the arrows **258**, **260** sequentially to push the stoppers of the tubes contained in the cartridge onto a single needle **190'**.

The block **188'** carrying the single needle **190'** is disposed in a socket indicated at **262** provided in a support member **264** which is reciprocated in a step-by-step manner by a solenoid **266**. The solenoid **266** is connected to the support member **264** by means of a connecting device **268**. The device **268** comprises a pivotally mounted hook **270** which is arranged to engage notches **272**, **274** provided on the support member **264**. A spring **276** is arranged yieldably to engage the hook with the notches. The solenoid **266** comprises a plunger **278** which extends through an opening in the device **268**, the distal end of the plunger **278** being provided with an enlarged end **280** which serves loosely to connect the end of the plunger to the device **268**. A spring **282** is arranged conventionally to urge the plunger **278** to its outermost position in the solenoid **266**. I have illustrated a trip release **284** for manually disengaging the hook **270** from the notches **272**, **274** and a spring **286** for biasing the support member **264** to its illustrated position.

The connecting device **268** is mounted for slidable movement relative to the support member **264** within the limits established by the elongated slots **288**. Assuming that the illustrated position of the support member **264** is its initial starting position and that the needle **190'** has been penetrated through the opening **120'** of the cartridge **56** and the stopper of the tube aligned with that opening and that it is desired to move the needle **190'** into alignment with the opening **122'**, this movement is accomplished by energizing the solenoid **266** while the hook **270** is engaged with the notch **272** to move the needle **190'** one step as indicated by the arrow **290**. Then the cartridge **56** is driven in the direction of the arrow **258** to push the stopper of the tube aligned with the opening **122'** upon the needle **190'**. While the needle **190'** is extending through the stopper behind the opening **122'**, the solenoid **266** is deenergized and the spring **282** moves the connecting device **268** to the left as viewed in FIG. **8** and relative to the support member **264** to engage the hook **270** with the notch **274**. Then, after the cartridge **56** is pulled in the direction of the arrow **260**, the solenoid **266** may again be energized to move the needle **190'** one step as indicated by the arrow **292** to position the needle **190'** in alignment with the opening **124'**. When the needle **190'** is aligned with the opening **124'**, the cartridge **56** can be pushed in the direction of the arrow **258** to penetrate the needle through the stopper of the tube in alignment with the opening **124'**. When the blood is deposited into the tube in alignment with the opening **124'**, the blood-collecting operation is completed and while the needle **190'** is still penetrating through the stopper of the tube aligned with the opening **124'**, the cartridge **56** with the needle and block **188'** connected thereto can be lifted out of the guideway **252**. Then, the supporting member **264** can be returned to its initial starting position by pushing down on the trip **284** which disengages the hook **270** from the notch **274**.

It will be appreciated that, in each of the devices **178**, **210**, **230**, **250**, I may use a solenoid for driving the single needle **190** through the stopper of each of the tubes in the cartridges **146**, **56**.

In order to prevent the blood which is contained in the needle **194**, tube **192** and block **188** from running out the open end of the needle **194** after it is removed from a vein, I prefer to leave the needle **190** penetrating into the last three test tubes into which the needle is inserted. After the person from whom the blood specimens have been taken leaves the area, the nurse or technician taking the blood can remove the needle **190** from the last of the three tubes which is filled and then deposit the needle, block **188**, flexible tube **192** and needle **194** into a trash container.

Referring now to FIG. **9**, it will be seen that I have illustrated a chuck means **300** for releasably, but rigidly holding a hollow needle **302** so that stoppers of evacuated tubes can be pushed upon the needle, the needle being connected by means of a flexible tube **304** to a vein puncturing needle (not shown).

The illustrative chuck means **300** includes a member **306** providing a surface **306*a*** having a trough **308** formed therein for receiving the needle **302**, a second member **310** providing a second surface **310*a*** for engaging the first-mentioned surface **306*a***, means **312** for hingedly connecting the members **306**, **310** so that the surfaces **306*a*** and **310*a*** can be separated, and fastener means **314** for releasably holding the surfaces in engagement. The illustrative fastener means **314** includes a wing screw **316** which is conventionally rotatable to bridge across a notch **318** provided in the member **310**.

In some cases, it may be sufficient to provide a resilient pad, such as indicated at **320**, on the surface **310*a***, which pad resiliently engages the needle **302** securely to position the needle in the trough **308** of the chuck means **300**. In other cases, it may be desirable to provide a small plastic block, such as indicated at **322**, which is molded so as to be rigidly connected to the needle **302** and which is received in a recess **324** formed in the surface **306*a***. It will be appreciated that the engagement of the block **322** with the recess **324** will, when the surfaces **306*a*** and **310*a*** are brought into engagement, position when needle **302** against longitudinal movement.

Thus, a nurse or technician using the chuck means **300** may simply raise the upper member **310** and insert a needle **302** into the trough **308** as indicated by the arrows **326** and then, close the chuck means by lowering the upper member **310** and operating the fastener means **314**.

It will be appreciated that, by using the chuck means **300**, it will be possible to eliminate the block **188**, **188'** shown in FIGS. **5–8**, the block being a plastic piece of material having a passageway formed therein with a flexible tube connected to one end of the passageway and a needle extending into and connected to the other end of the passageway. The formation of such a block will be significantly more expensive than the connection of the needle **302** to one end of the flexible tube **304**. While I have illustrated (FIG. **9**) the small block **322** molded about the end of the flexible tube receiving the hollow needle **302**, as stated above, I may provide chuck means **300** which will resiliently and frictionally engage the needle and hold the needle rigidly without using such a block. In such a case, the flexible tube **304** may be simply heat sealed to the needle **302**.

My illustrative chuck means **300** may be used in any one of the systems illustrated in FIGS. **5–8**. That is, the chuck means **300** may be placed on the rack **200** (FIG. **5**), on the support member **224** (FIG. **6**), on the support member **240** (FIG. **7**), or on the support member **264** (FIG. **8**).

Referring now to FIG. **10**, it will be seen that I have shown an illustrative chuck means **300'** mounted on a support block **330** for reciprocation in the direction of the arrow **332** which is parallel to the longitudinal axis of the needle **302** held in the chuck. The illustrative chuck means **300'** includes an illustrative snap fastener **334** in lieu of the rotatable-type fastener means **314** discussed above.

The support member **330** is formed with an upwardly opening, longitudinally extending cavity **336** for receiving a conventional evacuated tube **338**, the end of the cavity **336** facing the chuck means **300'** being enlarged as indicated at **340** to receive the stopper **338*a*** sealing such a tube. The tube **338** may be dropped into the cavity **336** and then the chuck means **300'** may be pushed manually toward the tube to penetrate the needle **302** carried by the chuck means through the stopper **338*a***. After blood is drawn into the evacuated tube **338**, the chuck means can be pulled away from the cavity **336**

and the tube can be removed from the cavity and a second tube can be placed therein. The device of FIG. 10, therefore, is a manual means for sequentially penetrating the needle 302, which is connected by a flexible tube 304 to a vein-puncturing needle, through the stoppers of several evacuated tubes.

In order to facilitate the manual removal of the tubes 338 from the cavity 336, I provide enlarged, laterally extending openings 342 intermediate the ends of the cavity. These openings 342 will permit a nurse or technician to grip the tube securely at a point intermediate its ends.

Referring now to FIG. 11, it will be seen that I have illustrated a chuck means 300' for releasably and rigidly holding a hollow needle 302 and means 344 for reciprocating the chuck means toward and away from the stoppers of a plurality of tubes. The illustrative means 344 includes a bidirectional drive motor 346 and drivescrew arrangement 348 for reciprocating the chuck means 300 as indicated by the arrow 350.

In FIG. 11, the tubes 352 are carried by a cartridge belt 354, i.e., a belt formed with a plurality of spaced apart loops 356, each of which receives a tube 352. Each loop 356 of the belt 354 is preferably provided with coded indicia for identifying the tube received therein. Preferably, means such as the illustrated knife 358 which is pivotally mounted as indicated at 360, will be provided for separating the belt loops 356. In the illustrative embodiment, the knife 358 is pivotally mounted on the same member as the chuck means 300' so that when the chuck means is moved away from the tubes, the knife will drop down to separate the loop 356 from the belt 354. In some cases, it may be advisable to remove or to deactivate the knife 358 so that reciprocation of chuck means 300' will not separate belt loops.

In the illustrative embodiment, there is a frame 362 defining a guideway through which the belt 354 and tubes 352 move. At one point on the frame 362, there is provided a notch 364 through which the needle 302 reciprocates. Means must be provided for driving the belt 354 in a step-by-step manner past the notch 364. In the illustrative embodiment, this function is provided by a rotary stepping motor 366 which drives a drive wheel 368 which engages the belt 354. The drive wheel 368 may be soft so as resiliently to engage the belt 354 as illustrated. Preferably, each step of the motor 366 moves the belt 354 one loop space sequentially to advance each tube 352 carried by the belt past the notch 364.

The system of FIG. 11 may be ideally used for collecting large groups of blood specimens from large groups of people, such as Army inductees. The coded indicia or serial numbers carried on each loop 356 will facilitate the identification of each blood specimen. That is, each person from whom blood is to be taken can be assigned a serial number corresponding to the number of the loop 356 receiving the tube 352 into which the person's blood is deposited. Thus, using the system of FIG. 11, one or more blood specimens can be efficiently taken from each person of a group of people. The nurse or technician taking the specimens will not have to manipulate manually the tubes.

The rotary stepping motor 366 and drive wheel 368 constitute indexing means for advancing the tubes 352 or the belt 354 holding the tubes sequentially past the chuck means 300' which holds the needles to be penetrated through the stoppers of the tubes.

Referring now to FIG. 12, it will be seen that I have shown a block 188 carrying a needle 190, the block being mounted on a platform 30'. The hollow needle 190 is connected by means of a flexible tube 192 to a vein-puncturing needle. The block 188 is illustrative and chuck means 300 may be used in lieu thereof.

The system of FIG. 12 includes a chamber 382 in which tubes 384 are held for movement toward and away from the needle 190. In the illustrative embodiment, the chamber 382 is reciprocated toward and away from the needle 190 by means of a bidirectional motor 384 and drivescrew 386 arrangement. The system of FIG. 12 also includes cartridge means or a hopper 388 for sequentially feeding such tubes 384 into the chamber 382 and means 390 for ejecting filled tubes from the chamber so that empty tubes can be deposited therein. In the illustrative embodiment, the ejecting means 390 comprises a member 392 mounted for pivotal movement as indicated at 394 toward and away from the chamber 382 as indicated by the arrow 395. The member 392 provides a portion 396 for engaging a tube 384 and pushing it out of the chamber 382. The ejecting means 390 also includes a second member 398 which is pivotally mounted on a platform 400 so as to engage a portion 402 of the member 392 when the chamber 382 is moved away from the needle 190 toward the cartridge means 388. The member 398 is pivotally movable as indicated by the arrow 404 and a leaf spring 406 is provided for yieldably urging the member 398 in a direction opposite to the arrow 404.

In the operation of the system of FIG. 12, when the chamber 382 with a tube 384 is moved away from the needle 190 toward the cartridge means 388, the member 392 strikes the member 398 and moves inwardly to push the tube out of the chamber as indicated by the arrow 408. The chamber 382 continues to move to a position under the cartridge means 388 so that another tube 384 can drop into the chamber for movement toward the needle 190. The spring 406 will permit the member 398 to pivot in the direction of the arrow 404 when the member 392 is moved toward the needle 190.

It will be appreciated that the entire system of FIG. 12 may be mounted on an oscillable platform 30', only a portion of which is shown.

What is claimed is:

1. A blood collecting device comprising means for holding conventional evacuated test tubes, each such tube being sealed with a conventional rubberlike stopper, hollow needle means for penetrating through such stoppers and into such tubes, a vein-puncturing hollow needle, flexible tube means for connecting said needle means to said vein-puncturing needle, said holding means being arranged to hold such tubes so that such stoppers face said needle means, drive means for providing relative reciprocation between said needle means and said holding means to cause said needle means to penetrate through such stoppers, and means for gently oscillating said holding means and such tubes held thereby.

2. The device of claim 1 in which said drive means is electrically operated and including circuit means for preventing energization of said drive means unless said holding means is oscillating.

3. A blood collecting device comprising a manifold providing a passageway, a plurality of hollow needles carried by said manifold and communicating with said passageway, each of said hollow needles having a sharpened end portion extending away from said manifold, a vein-puncturing hollow needle, flexible tube means for connecting said vein-puncturing needle to said passageway, frame means for holding a plurality of conventional evacuated test tubes, each such tube being sealed with a conventional rubberlike stopper, said frame means being arranged to hold each such tube in a position so that its stopper is facing the sharpened end portion of one of said first-mentioned needles, drive means for providing relative reciprocation between said manifold and said frame means to cause the sharpened end portions of said first-mentioned needles simultaneously and respectively to penetrate through said stoppers and into said tubes, and means for gently oscillating said frame means and such tubes held thereby.

4. The device of claim 3 in which said drive means is electrically operated.

5. The device of claim 4 in which said oscillating means is electrically operated and including circuit means for assuring that said oscillating means is energized before said drive means can be energized.

6. A blood collecting device comprising a manifold providing a passageway, a plurality of hollow needles carried by said manifold and communicating with said passageway, each of

said hollow needles having a sharpened end portion extending away from said manifold, a vein-puncturing hollow needle, flexible tube means for connecting said vein-puncturing needle to said passageway, frame means for holding a plurality of conventional evacuated test tubes, each such tube being sealed with a conventional rubberlike stopper, said frame means being arranged to hold each such tube in a position so that its stopper is facing the sharpened end portion of one of said first-mentioned needles, drive means for providing relative reciprocation between said manifold and said frame means to cause the sharpened end portions of said first-mentioned needles simultaneously and respectively to penetrate through said stoppers and into said tubes, a platform upon which said frame means, manifold, and drive means are mounted, and means for gently oscillating said platform.

7. The device of claim 6 in which said platform provides a guideway for reciprocably mounting sad frame means and in which said drive means is arranged to move said frame means along sad guideway toward said manifold.

8. The device of claim 6 in which said oscillating means includes a motor, a bent shaft driven by said motor, and a bearing for coupling said platform to said shaft, said bearing having an outer race upon which said platform is mounted and an inner race mounted on said shaft.

9. A blood collecting device comprising means for holding conventional evacuated test tubes, each such tube being sealed with a conventional rubberlike stopper, hollow needle means for penetrating through such stoppers and into such tubes, a vein-puncturing hollow needle, flexible tube means for connecting said needle means to said vein-puncturing needle, said holding means being arranged to hold such tubes so that such stoppers face said needle means, power means for providing relative reciprocation between said needle means and said holding means to cause said needle means to penetrate through such stoppers, and means for gently oscillating said holding means and such tubes held thereby.

10. The device of claim 1 in which said needle means includes a second hollow needle and means for rigidly holding said second needle, and including indexing means for providing relative movement between said holding means and said second needle, said indexing means being arranged so that the stoppers of such tubes are sequentially disposed adjacent said second needle to be penetrated thereby.

11. A blood specimen collecting device comprising a vein-puncturing hollow needle, means for supporting a plurality of test tubes, each such tube being closed by sealing means disposed in the end thereof, hollow needle means, means for penetrating said hollow needle means through such sealing means and into such tubes, said penetrating means including power means for providing relative reciprocation between said hollow needle means and said supporting means, and means for gently oscillating said supporting means and the tubes supported thereby.

12. The device of claim 11 in which said hollow needle means includes a second hollow needle, and in which said penetrating means includes indexing means for providing relative movement between said supporting means and said second hollow needle, said indexing means being arranged so that the sealing means of such tubes are sequentially disposed adjacent said second needle to be penetrated thereby.

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