United States Patent

[11] 3,626,929

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[21] Appl. No. **843,016**
[22] Filed **July 18, 1969**
[45] Patented **Dec. 14, 1971**
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Philadelphia, Pa.
[32] Priority **July 26, 1968**
[33] **Switzerland**
[31] **11272/68**

[54] **APPARATUS FOR OBTAINING A PERCUTANEOUS AND DIGITAL BLOOD SAMPLE**
12 Claims, 16 Drawing Figs.

[52] **U.S. Cl.** ..... **128/2 R,** 128/275
[51] **Int. Cl.** **A61b 10/00**
[50] **Field of Search** ..... 128/253, 329, 333, 314, 315, 253, 2, DIG. 5, 275; 119/14.24, 14.25

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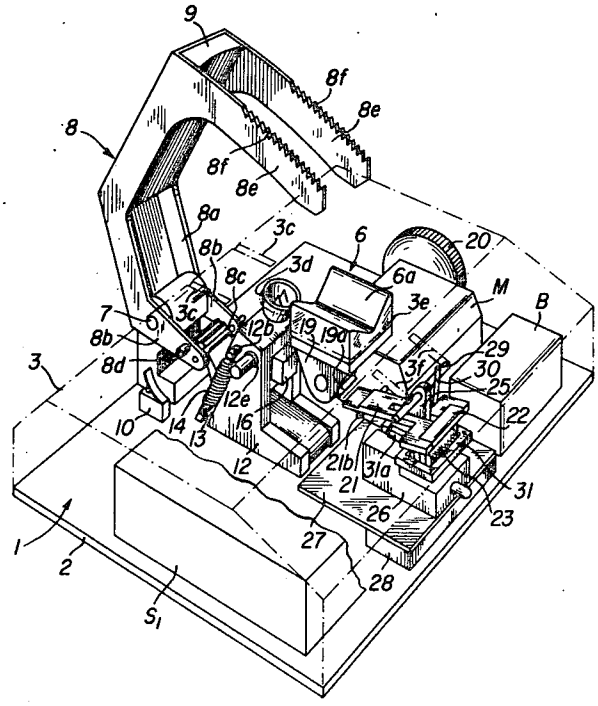
Assistant Examiner—Kyle L. Howell
Attorneys—George W. F. Simmons, Gerry J. Elman and Arthur R. Eglington

ABSTRACT: Apparatus for automatically obtaining a percutaneous and digital blood sample in conjunction with a blood collector device having a resiliently crushable mouthpiece housing a pair of incisor lancets, the apparatus including a mounting for the collector device, clamping means for holding the tip of a finger on the crushable mouthpiece, a mechanism for striking the collector device in the mounting to drive the lancets into the finger, and means for massaging the finger to cause blood to flow out of the resulting incisions.



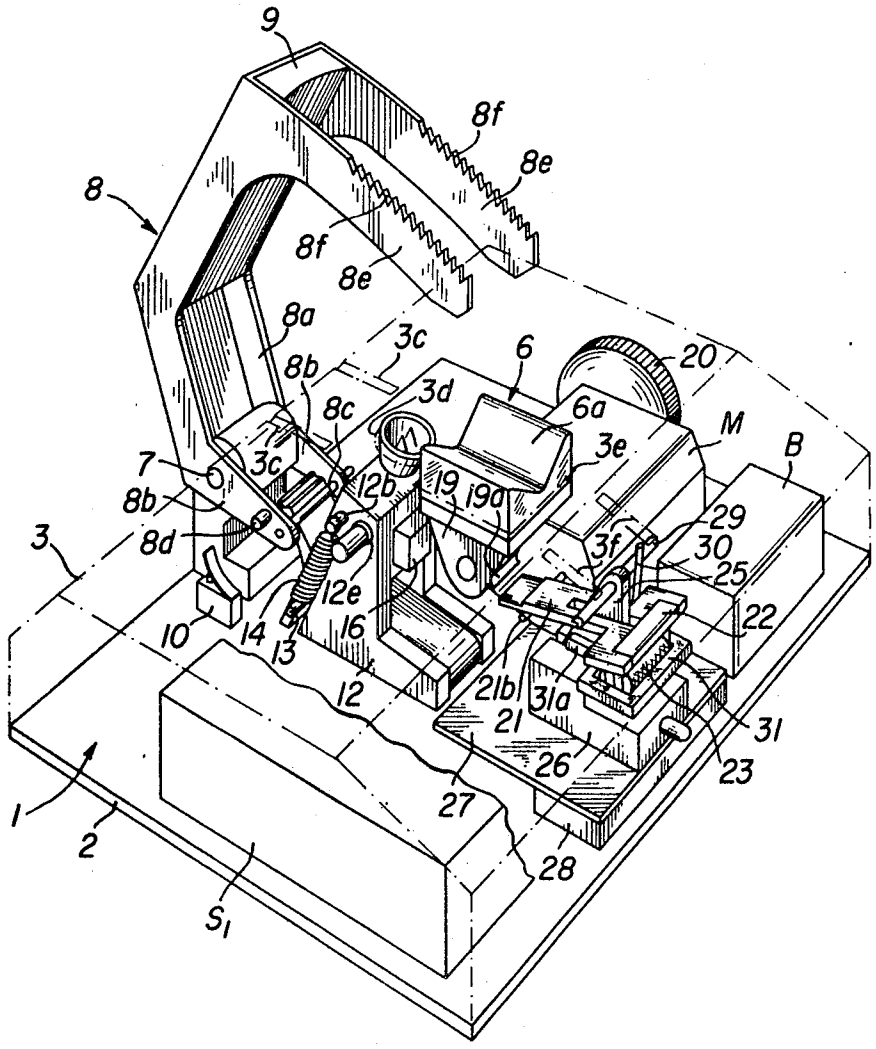

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FIG. 1

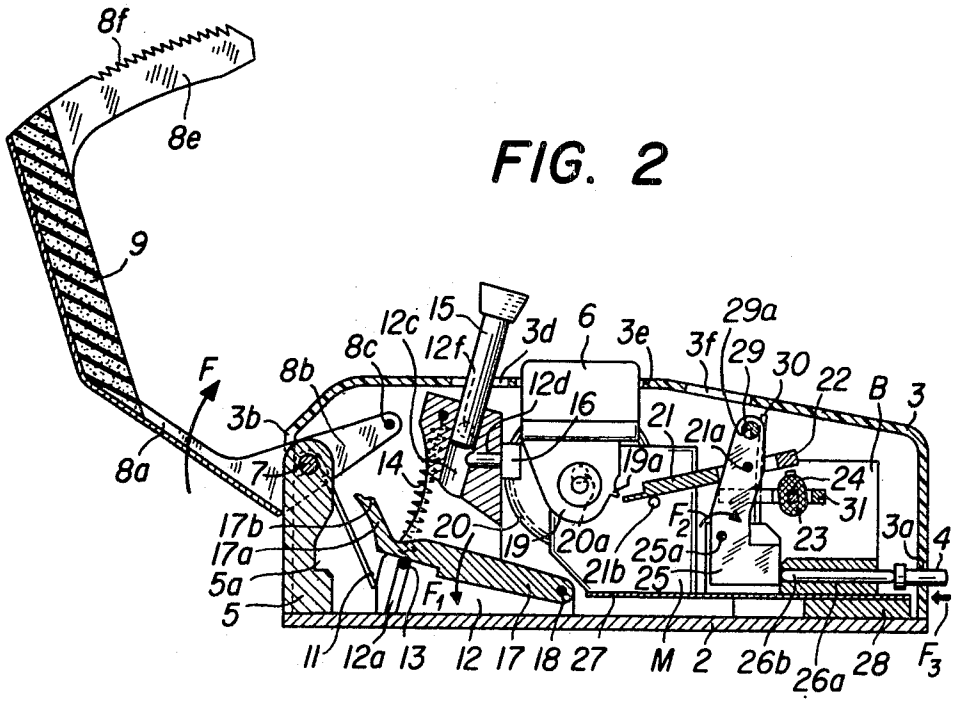
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FIG. 2

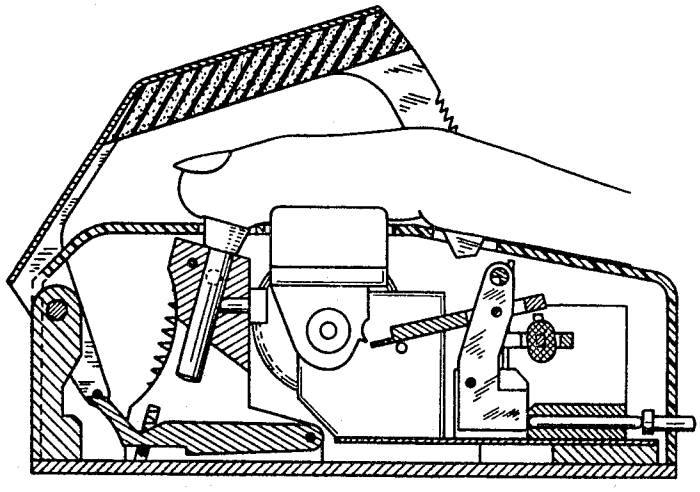


FIG. 3

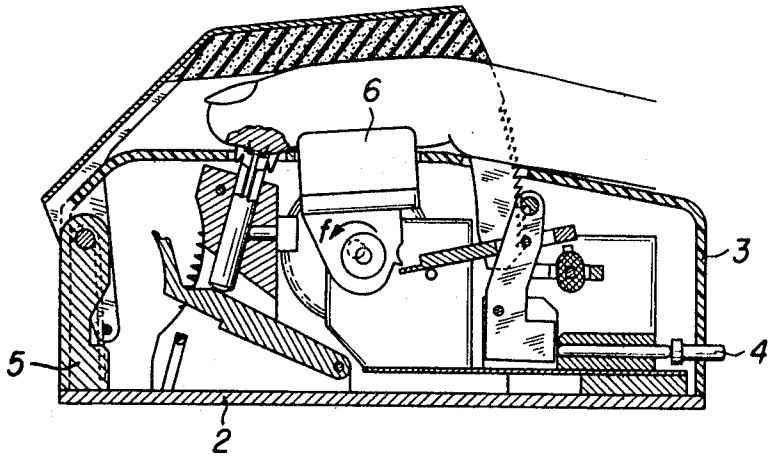


FIG. 4

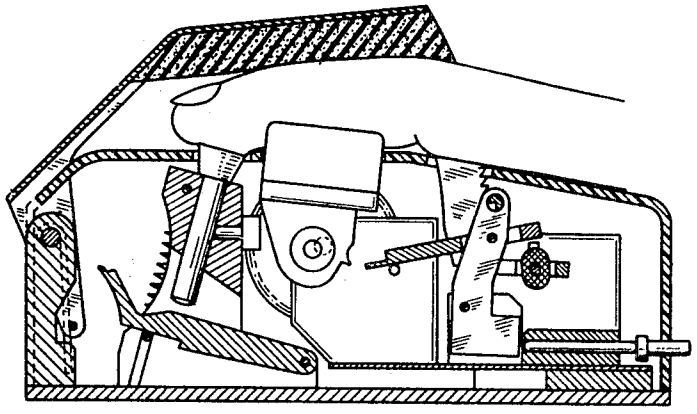


FIG. 5

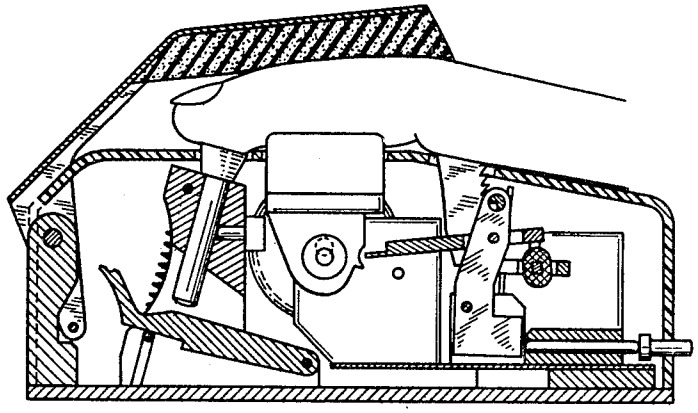


FIG. 6

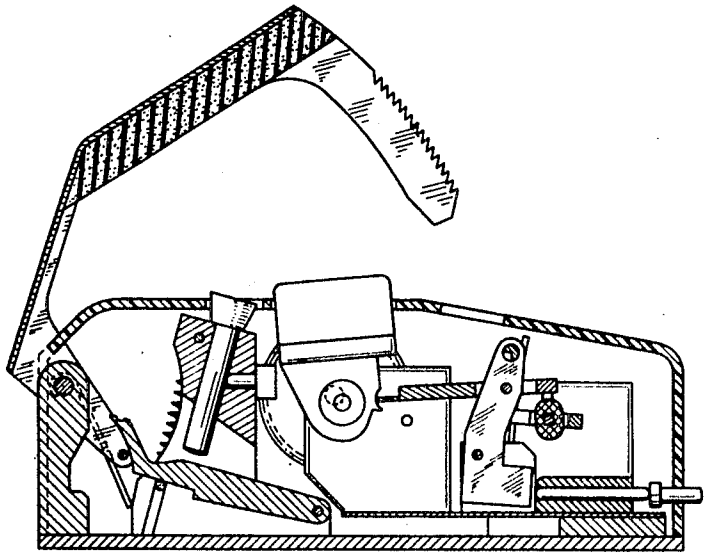


FIG. 7

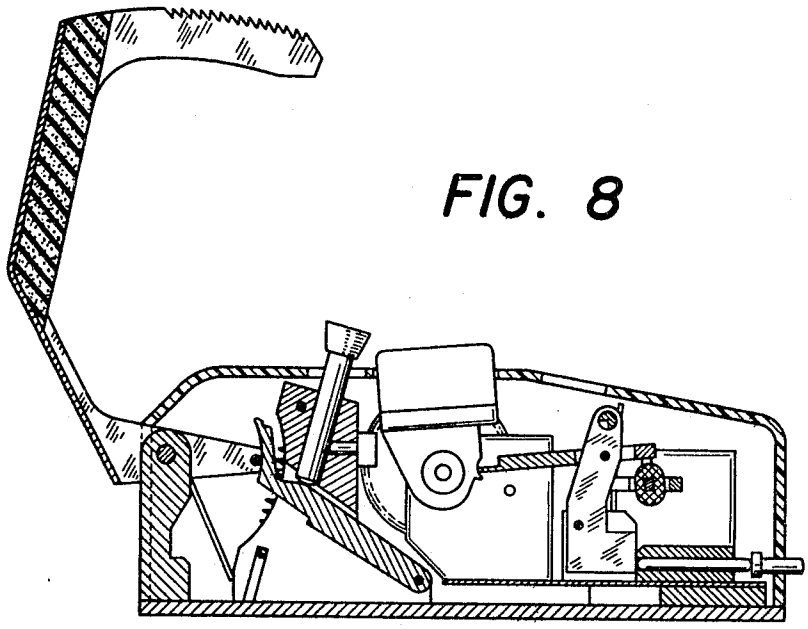


FIG. 8

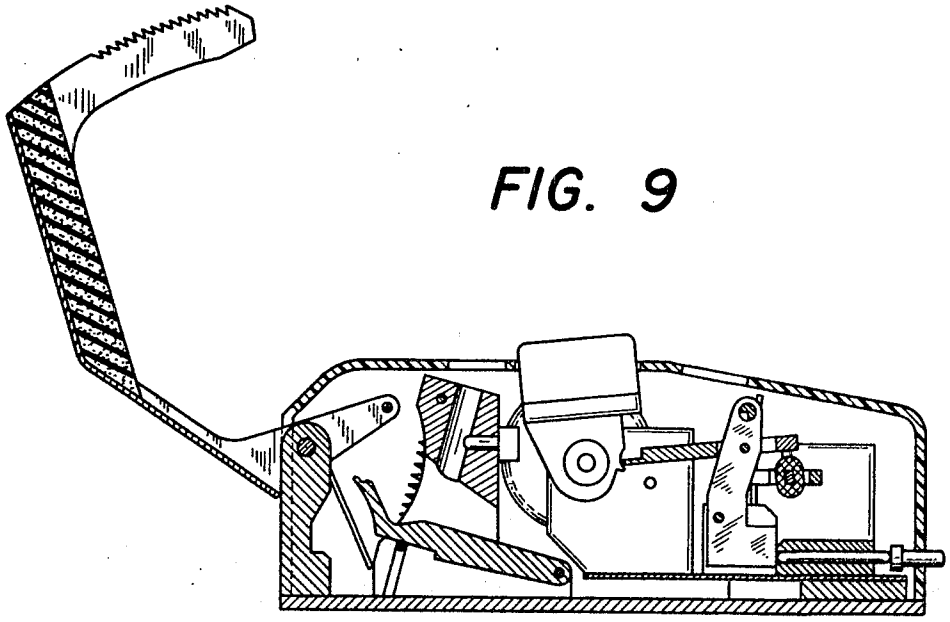
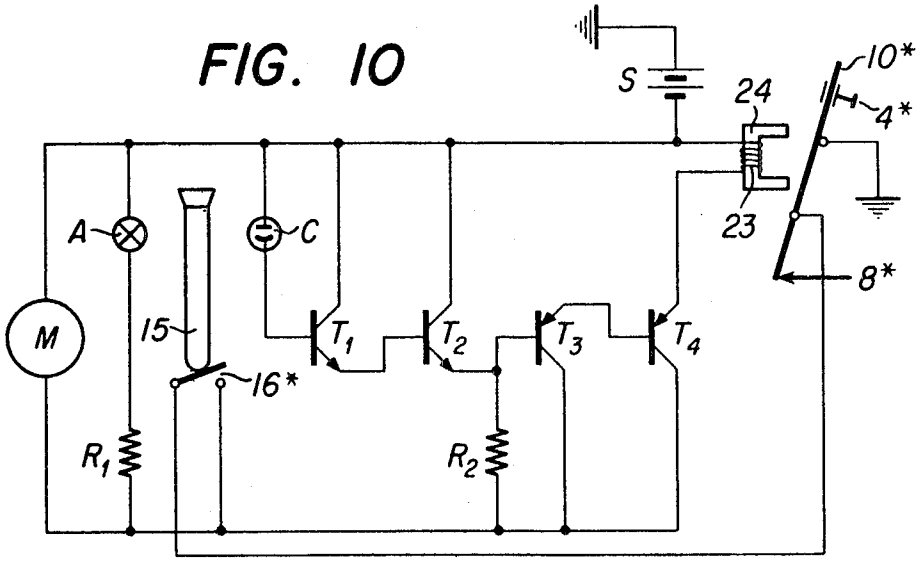


FIG. 9

FIG. 10



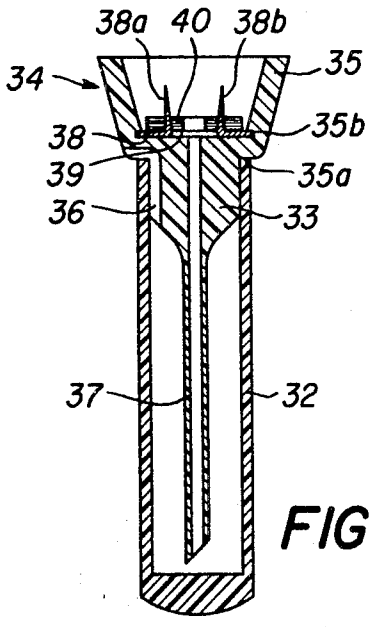


FIG. 11

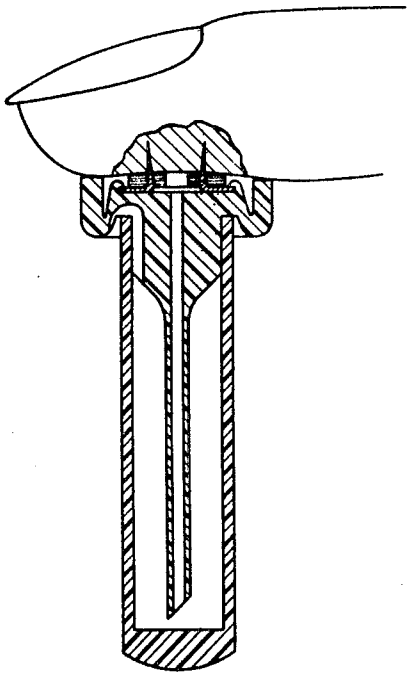


FIG. 12

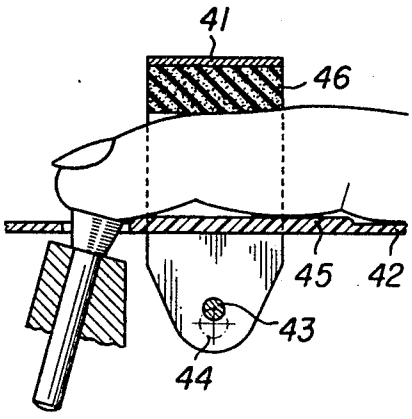


FIG. 13

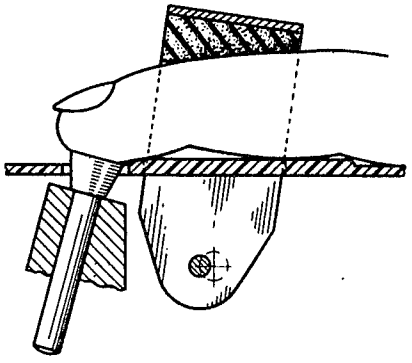


FIG. 14

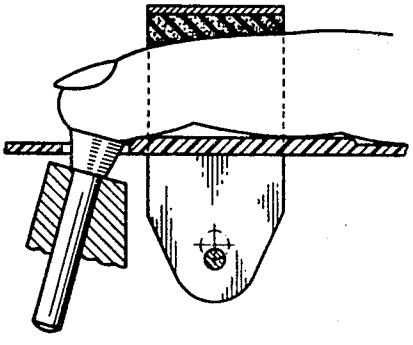


FIG. 15

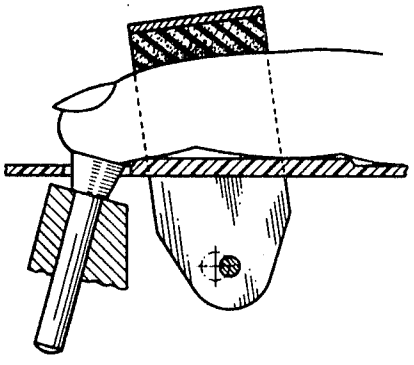


FIG. 16

APPARATUS FOR OBTAINING A PERCUTANEOUS AND DIGITAL BLOOD SAMPLE

This invention relates to apparatus for obtaining a percutaneous and digital blood sample.

A percutaneous and digital blood sample can be obtained as follows: once the finger has been disinfected, its skin is pricked by means of a stylet to a depth of about 2 to 3 mm.; this causes a first drop of blood to appear that contains a relatively substantial quantity of liquid originating from the subcutaneous cells and which is eliminated by swabbing it with, for example, cotton wool. The pricked finger is then massaged towards the incision to urge further drops of blood to appear and these further drops are collected in a test tube or a capillary, or are sucked into a tube open at both ends.

The different stages of taking a blood sample are generally carried out by specialist personnel although some of these stages, in particular the preliminary preparation of the finger to be pricked, could quite readily be carried out by the subject himself.

An object of the invention is to automate the various operations that are involved in the taking of a percutaneous and digital blood sample in such a way that the subject from whom the sample is to be taken can himself take this sample, practically without the intervention of trained personnel.

According to the invention there is provided apparatus for obtaining a percutaneous and digital blood sample in conjunction with a blood collector device which comprises a tube in the month of which is fitted a resilient funnel member fitted with at least one incisor lancet directed towards the open end of the funnel member, said apparatus comprising a mounting formed with a through passage in which said tube can be removably inserted up to said funnel member to support the blood collector device, said through passage having a length less than the length of said tube whereby the inner end of the tube will project out of the rear end of said through passage when said funnel member comes into contact with the mounting adjacent the front end of said through passage; a striker mechanism having a releasable striking member facing the rear end of said through passage and adapted to strike, when released, the inner end portion of the tube, when the latter is inserted in said through passage, thereby to tend to propel said tube out of said through passage so that when a portion of the finger from which a blood sample is to be taken is placed on the funnel member at the open end thereof, said resilient funnel member is caused to deform to allow said lancet to be driven into the finger to effect a percutaneous incision therein; a clamping finger holder; and means for periodically varying the clamping action of said holder whereby at least part of the tissues of a finger in said holder may alternately be constricted and released.

In the accompanying diagrammatic drawings:

FIG. 1 is a perspective transparent view showing the main component parts of one construction form of apparatus according to the invention;

FIGS. 2 to 9 are sections taken across the middle of the apparatus shown in FIG. 1, showing the various positions occupied by the component parts of this apparatus in the course of a blood sampling operation;

FIG. 10 is a diagram of the electric control circuit of the apparatus shown in FIG. 1;

FIGS. 11 and 12 are sectional elevations of a blood collector device that can be used with the FIG. 1 apparatus, and

FIGS. 13 to 16 show, in sectional elevation, various stages in the operation of a modified detail of the FIG. 1 constructional form of apparatus.

The apparatus shown in FIGS. 1 to 9 comprises a casing 1 having a base 2, formed by a rectangular plate, and a covering body 3 removably mounted on the base 2. The base 2 and the body 3 are preferably made of a synthetic plastics material.

The body 3 is formed in its front wall with a circular opening 3*a* (FIG. 2) through which projects a pushbutton 4; in its rear wall with a rectangular cutout 3*b* which extends over the entire height of the rear wall to accommodate a block 5 secured to the base 2; and in its top wall with a pair of rectilinear parallel slots 3*c* which extend from the upper edge of the cutout 3*b* toward the front, with a first, circular, opening 3*d* located in front of the slots 3*c*, a second, rectangular, window 3*e* through which projects a block 6, and with another pair of rectilinear parallel slots 3*f* which are located between the opening 3*e* and the front wall and which are in alignment with the slots 3*c*.

Block 5 has pivotally mounted on the upper portion thereof, at 7, a shackle 8 having a hollow portion 8*a* of U cross section in which is secured, as by adhesive, a pad of synthetic sponge 9. In the region of pivot 7, the shackle 8 is formed with a pair of parallel lugs 8*b* coplanar with the limbs of portion 8*a* and connected to one another by a pin 8*c* (FIG. 1). One of the lugs 8*b* has secured to the outside thereof a stud 8*d* adapted to actuate a switch 10, mounted on the base 2 beside block 5, when the shackle 8 reaches a predetermined angular position upon being swung clockwise about pivot 7, as will be explained in greater detail further on.

The spacing between lugs 8*b* is equal to that between the slots 3*c* and their thickness is slightly less than the width of these slots so that they may move freely therethrough when the shackle 8 is swung backwards and forwards as for example between the positions shown in FIG. 2 and in FIG. 4.

On the pivot 7 is mounted a spring 11 having a downwardly projecting arm on which the pin 8*c* can come to bear whenever the shackle 8 is moved clockwise into the position shown in FIG. 3 and beyond (FIGS. 4 to 6).

At the end remote from the pivot 7, the shackle 8 is extended by a pair of parallel arms 8*e* coplanar with the limbs of the central portion 8*a* and having a slightly arcuate outline centered on pivot 7. The distance between the center line of each arm 8*e* and the axis of pivot 7 is substantially equal to the distance between this axis and the middle of each slot 3*f*. Moreover, the spacing between the arms 8*e* is equal to that between the slots 3*f* whereas their width and their thickness are slightly less than the length and the width of these slots so that when the shackle 8 is swung clockwise or forward, for example to the position shown in FIG. 4, its arms 8*e* may pass freely into the slots 3*f*, over their entire length if need be. The outer edges of the arms 8*e* are moreover each formed with a series of saw teeth 8*f*.

In front of the block 5 is provided a mounting 12 having a transverse portion at the top thereof and a pair of legs which are secured to the base 2 and which are formed with a pair of upwardly extending slots 12*a* wherein are slidably mounted the end portions of a pin 13 subjected to the action of a pair of tension springs 14 on the outside of the mounting 12 and secured at their top ends to a pair of studs 12*b*.

The transverse portion of the mounting 12, which lies beneath the opening 3*d* in the casing body, is formed with several passages, i.e., a first passage, 12*c*, which extends generally upwardly though the middle of the transverse portion and which lies opposite the opening 3*d*, a second passage, 12*d*, which extends horizontally through part of the transverse portion between the passage 12*c* and the front face of the mounting 12; and third and fourth passages, 12*e* (FIG. 1) and 12*f* (FIG. 2), which extend horizontally and coaxially from the passage 12*c* to the opposite side faces of the mounting 12, passages 12*e* and 12*f* lying at a level slightly higher than passage 12*d* and at right angles to the latter.

Passage 12*c* is adapted slidably to receive a tube forming part of a blood collector device 15 which will be described in greater detail later with reference to FIG. 11; the length of passage 12*c* is less than that of the tube. Passage 12*d* has slidably mounted therein an actuating element for controlling a switch 16 which is mounted on the front face of the mounting 12 and the utility of which will become apparent later. Passage 12*e* serves to house a photoelectric cell C (FIG. 10) and passage 12*f* serves to house an electric bulb A (FIG. 10) for illuminating the cell C.

Between the legs of the mounting 12 there is pivotally mounted a lever 17 on a pin 18 whose end portions extend into the legs. The lever 17 is made of a material having a rela-

tively high specific weight, e.g., brass or copper, and rests on the sliding pin **13**. At its free end, the lever **17** is formed with an upwardly turned portion **17***a* in the tip of which is formed a groove **17***b* parallel to its pivotal axis The width of the lever **17** is less than the spacing between the lugs **8***b* of shackle **8** to allow relative movement between these parts.

It should be noted that the position of the mounting **12** on the base **2** is so chosen that the mean vertical plane of the mounting, along which the cross sections of FIGS. **2** to **9** have been made, is also the mean plane of the shackle **8**. Further, the length of the springs **14**, the length of lever **17** and the position of the pivotal pin **18** are such that when the shackle **8** is swung clockwise or forwards in the direction of arrow F (FIG. **2**), the pin **8***c*, in the course of its circular motion, comes into engagement with the lever **17**, in particular with its upwardly turned portion **17***a* (FIG. **2**), and the circular path traveled by the tip of this portion **17***a*, when lever **17** is moved anticlockwise by the pin **8***c* in the direction of arrow F_1 against the action of springs **14**, moves away from that travelled by the pin **8***c* before the latter comes into contact with the block **5** and in particular reaches the bottom of a notch **5***a* formed in this block (FIG. **3**).

Thus, if the shackle **8** is swung in the direction F (FIG. **2**), the springs **14** are caused to tension as soon as the pin **8***c* comes into contact with lever **17** and this tensioning action will continue until the circular paths travelled by the pin **8***c* and by the tip of lever portion **17***a* cease to intersect one another, i.e., shortly after the pin **8***c* has entered into the retaining groove **17***b* formed along the tip of lever portion **17***a*.

If the swinging motion of the shackle **8** is continued in the direction of arrow F, the pin **8***c* moves out of the groove **17***c* and altogether disengages the lever **17** so that the latter, through being released, finds itself suddenly subjected to the sole action of the tensioned springs **14** which cause it to swing abruptly in a direction opposite to that of F_1, i.e., towards the passage **12***c* in the mounting **12** thereby to strike the base of the blood collecting tube of device **15** (FIG. **4**). The effect of this striking action will be described further on.

The illustrated apparatus comprises, as already stated, a block **6** which projects through an opening **3***e* formed in the top wall of the casing body **3**. This block **6** is formed in its upper surface with a V-shaped recess **6***a* and is fixed to a lever **19** mounted on an eccentric (not shown) driven by the output shaft **20** *a* powered by an electric motor M via a speed reducing gear of which one wheel can be seen at **20** in the drawings. The lever **19** is formed with an abutment **19***a* adapted to engage one end of a lever **21** carrying the armature **22** of a relay having a winding **23** and a magnetic circuit **24**. The lever **21** is pivotally mounted at **21***a* on a further lever **25** which is in turn pivotally mounted at **25***a* on a block **26** secured to a platform **27** which also supports the motor M and which in turn rests on the base **2** of the apparatus via a socle **28**. Through the top end of lever **25** extends a stem **29** in which is formed a notch **29***a* extending along its entire length thereby to form a sufficiently sharp catch to engage with the teeth **8***f* along the front edges of the arms **8***e* of shackle **8** when the latter has been swung down (FIGS. **4** to **6**).

A spring **30** which is secured at one end to the block **26** and which bears near its opposite end on the stem **29** serves to keep the latter in a position of engagement. The magnetic circuit **24** and its winding **23** are mounted in the opening of a supporting frame **31** to one side of which are provided a pair of projecting lugs **31***a* by means of which the frame **31** can be mounted on lever **25**, the lugs being secured to the opposite faces of lever **25**.

The block **26** is formed with a horizontal passage **26***a* through which extends a slidable pin **26***b* whose ends contact the lever **25** and the pushbutton **4** respectively. Thus, by pressing on the button **4** in the direction of arrow F_3, the lever **25** can be made to rotate in the direction of arrow F_2 about its pivotal axis **25***a* and against the action of the spring **30**.

As for lever **21**, it can occupy either of two positions depending on whether or not the relay winding **23** is energized. In the position which corresponds to the unenergized state of the winding **23** and which is that shown for instance in FIGS. **1** and **2**, lever **21** comes to bear under the action of its own weight on a pin **21***b* secured to the casing of motor M, so that the projection **19***a* on lever **19** cannot come into contact with lever **21**, whatever may be the position occupied by lever **19** in the course of its eccentric motion. But upon energization of the winding **23**, a the field that is set up by the magnetic core **24** causes the armature **22** to be attracted thereby causing lever **21** to be rocked about its pivotal axis **21***a* into a raised position (FIGS. **6** and **7**) in which its tip comes to lie in the path of travel of the projection **19***a*. Upon this projection coming into engagement with lever **21** (FIG. **7**), the latter is tipped up thereby causing the whole unit that is made up of the lever **21**, the frame **31** that carries the winding **23** and its core **24**, the lever **25** and the notched stem **29**, to be rocked about pin **25***a* in the direction of arrow F_2. Thus if the shackle **8** happens to be at that time in its lowered position with its teeth **8***f* in meshing engagement with the notched stem **29**, then the latter will be made to disengage from these teeth thus causing the shackle **8** to be subjected to the sole action of its spring **11** and hence to be swung upwards in a direction opposite to arrow F (FIG. **2**).

A similar result can be achieved by pressing on the pushbutton **4** in the direction of arrow F_3, since in so doing pin **26***b* is caused to slide from right to left in the passage **26***a* to rock lever **25** in the direction of arrow F, this being the direction required to disengage the notched stem **29** from the teeth **8***f*.

The motor M, the lamp A and the winding **23** are supplied with electric current by means of a circuit which is diagrammatically illustrated by FIG. **10**. In this FIG. are also to be found the switches **10** and **16**, here referenced **10*** and **16***, the photoelectric cell C, the magnetic core **24** of winding **23**, and the pushbutton **4**, here referenced **4***. The positional relationship of elements **4**, **10**, **23** and **24** does not in this Figure correspond in any way to reality but their functional representation is however correct. Thus, upon lever **21** being attracted by the winding **23**, the shackle **8** is released from the stem **29** and swings upwards under the action of the spring **11** causing the stud **8***d* to open the switch **10**.

The same result can be achieved, as already stated, by actuating the pushbutton **4**, and this explains why there is shown a pushbutton **4*** acting directly on the movable contact of a switch **10***.

Moreover, because the shackle **8** is the member that governs the closure of the switch **10**, its function has here been symbolized by an arrow **8***.

As shown in FIG. **10**, the electric circuit of the apparatus, which is supplied with current by a source S consisting of a series of cells housed in a casing S_1 (FIG. **1**) secured to the base plate **2**, comprises an amplifier which includes a pair of NPN-type transistors, T_1 and T_2, a pair of PNP-type transistors, T_3 and T_4, and a resistor R_2, this amplifier being controlled by the photoelectric cell C and serving to ensure energization of the winding **23** upon receipt of a suitable signal from the cell C.

It should here be pointed out that the cell C and the source of illumination A serve to determine when the transparent or translucent tubular body of the collector device **15** has been filled with a sufficient quantity of blood, the cell producing signals which are different when receiving a light beam of full intensity from source A or a light beam of lesser intensity, as when the blood that has collected in the tube has reached the level of the light beam issuing from source A. It should however be noted that the supply of current to the light source A, which takes place through a resistor R_1, only occurs when the switches **10** and **16** are closed, i.e., only when the shackle **8** has been swung into its lowered position (FIG. **4**) and when a blood collector device **15** has been inserted into the passage **12***c* of the mounting **12**. The same applies to the motor M which can only be supplied with current when these switches have been closed.

Thus, upon the blood being collected in the tube of device **15** reaching the level of the light beam projected by the source A towards the photoelectric cell C, the switch **10** will be made to open the motor M will hence be made to stop.

The amplifier, consisting of transistors T_1 to T_4 and of resistor R_2, and the resistor R_1 are housed in a casing B mounted on the platform **27**.

Before describing the operation of the illustrated apparatus, a few particulars will be given about a preferred form of blood collector device that can be used in conjunction with the apparatus for taking and collecting a blood sample (FIG. **11**).

This device comprises a tubular body **32** of transparent or translucent material, for example polyethylene, in the mouth of which is engaged a plug **33** constituting the lower, discharge, part of a funnel member **34** having a cuplike portion **35** of resilient plastics material. The cup **35** rests on the rim of the mouth of the tubular body **32** by means of an annulus **35***a* provided at the base of the cup **35**. The wall of the cup **35** and the plug **33** are formed with an L-shaped groove **36** forming a passageway which allows the air contained in the tubular body **32** to escape as the latter is being filled with liquid, in particular blood.

At the lower end of plug **33** there projects a capillary cannula **37** extending nearly to the bottom of the body **32**, coaxial with said body and forming an extension of an axial passage in the plug **33**. The plug **33** and the cannula **37** form an integral unit made of synthetic resin.

At the bottom of the cup **35** is provided an annular groove **35***b* in which is held the peripheral part of a circular metal plate **38**, for example of stainless steel, which is provided with two triangular lancets **38***a* and **38***b* extending perpendicularly to the plate **38**, on opposite sides of a slot **39** in said plate.

Above the plate **38** in the cup **35** is arranged an annular pad **40** of absorbent material, e.g. blotting paper, impaled on and held in position by the lancets **38***a* and **38***b*. As shown, the slot **39** and the opening in the pad **40** lie opposite one another and are in alignment with the central passage in plug **33**.

The part of the lancets **38***a* and **38***b* that projects above the pad **40** has a length of at least 2 to 3 mm.; these lancets may extend further but not beyond the level of the upper rim of cup **35**.

It is these lancets **38***a* and **38***b* which are intended to form the cutaneous incisions that have to be made for taking a blood sample, as will now be seen.

The apparatus described with reference to FIGS. **1** to **9** operates as follows:

When the shackle **8** is in its raised position shown in FIGS. **1** and **2**, a blood collector device **15** is inserted through the opening **3***d* in the casing body **3**, and into the passage **12***c* of mounting **12** until the funnel member of the device **15** comes to rest on the mounting **12** at which point the lower end portion of its tubular body will project into the space lying between the legs of the mounting **12**, as shown in FIG. **3**.

Once the subject's finger from which a blood sample is to be taken has been duly cleaned and disinfected with dilute alcohol, at least over the fleshy part of the top joint (underneath the nail), the subject lays his hand on the apparatus casing **1** and places the tip of his disinfected finger on the mouth of the cup formed by the funnel member of device **15**, and places the middle joint and the adjoining part of the top joint of this finger in the V-shaped recess **6***a* that is provided in the block **6**.

The shackle is then moved in the direction of arrow F to bring it into the position shown in FIG. **4**. Once the shackle has travelled through a certain angular distance, the pin **8***c* comes into engagement with the top surface of the lever portion **17***a* to depress the lever **17** and hence to tension the springs **14**. When the pin **8***c* reaches the groove **17***b* along the tip of the lever portion **17***a* the arms **8***a* of the shackle start to extend through the slots **3***f* in the casing body **3** without however yet being in a position where the teeth **8***f* can begin to come into meshing engagement with the notched stem **29** (FIG. **3**). It is in this position of the shackle **8** that the pin **8***c* begins to bear on the spring **11**.

With the shackle **8** being moved further down, the pin **8***c* moves out of the groove **17***b* and slips off the cocked lever **17** thereby triggering off the latter to strike, under the action of the springs **14**, the base of the tubular body **32** of the blood collector device **15** (FIG. **4**). The device **15** cannot, as a unit, rise beyond the point where the subject's finger is resting on the top of its funnel member **34**, but because the walls of the cup **35** are collapsible, in view of the fact that the funnel member **34** is made of resilient material, and because the tubular body **32** is slidingly mounted in the passage **12***c* of mounting **12**, the tubular body **32** can nonetheless be made to move upwards under the percussive action of the striking lever **17** to drive the lancets **38***a* and **38***b* into the flesh of the finger (FIG. **12**) to a depth corresponding to the length of the projecting portions of the lancets, thereby making the desired incisions in the epidermis and the dermis.

Once lever **17** has imparted all its kinetic energy to the blood collector device, it ceases to exert any force on the latter and drops back on to the sliding pin **13**. Thus, once the desired incisions have been made, the tubular body **32** will be forced back to its initial position under the action of the deformed elastic walls of the cup **35** tending to resume their normal uncollapsed position (FIG. **11**), and the lancets **38***a* and **38***b* will be withdrawn from the incisions they have made although remaining in close proximity to the latter.

While the striking action is taking place, the shackle **8** will have reached the position shown in FIG. **4**. In this position the pad **9** has come to bear on the top of the first and second finger joints, the notched stem **29** has come into engagement with the teeth **8***f* provided along the shackle arms **8***e* and the stud **8***d* has caused the switch **10** to close so that the control circuit for the apparatus may supply electric current to the motor M, the lamp A and the cell C.

In this position of the shackle **8** also the finger finds itself tightly held between the block **6**, along the bottom, the pad-lined shackle portion **8***a*, along the top, and the limbs of the shackle portion **8***a*, along the sides, the grip exerted on the finger being variable, in particular in the plane of FIG. **4**. The variable gripping action exerted by the finger-holding arrangement is due to the fact that the block **6** is movably mounted and is eccentrically driven by the motor M in the direction of arrow *f* (FIG. **4**) since in the course of this eccentric motion, the block **6** is made to move to and from in relation to the incised tip of the finger and is also made to move upwards as it moves towards the incised finger tip and to move downwards as it moves away from the incised finger tip.

The finger thus finds itself being periodically subjected to a kind of massaging action from back to front by compression of the part of the finger that lies on the block **6**, and this massaging action causes the blood flowing to this part of the finger to be urged towards the incisions so as to issue therefrom in the form of drops which are collected in the cup of the funnel member of device **15**.

It is to be noted that the first few drops of blood thus collected in the cup contain a high proportion of physiological liquid which originates from the subcutaneous cells lying near the incisions and which is clearly undesirable in the blood sample. That is why there is provided at the bottom of the funnel member cup **35** an absorbent pad **40** which will soak up these few drops of impure blood and it is only when the pad **40** has been sufficiently impregnated with a mixture of physiological liquid and blood, that the clean blood then issuing from the finger will begin to flow into the tubular body **32**. In this connection it is to be noted that the lancets considerably facilitate this flow because, although removed from the epidermis, they remain directly opposite the incisions they have made and are at a sufficiently short distance from them to enable the drops of blood issuing from the incisions to fall on and be ruptured by the tips of the lancets, whereupon they will flow rapidly over the surface of the latter into the outlet opening of the funnel member **34**. The lancets thus play the part of effective collectors preventing the formation of a thick blood dispersion in the cup **35**.

When the level of the blood that has accumulated in the tubular body of the collector device **15** has reached a sufficiently high level to interrupt or interfere with the light beam directed to the cell C, the latter causes the relay winding **23** to be energized, as already described, thereby to move the lever **21** to its raised position (FIG. **6**) and hence to release the shackle **8** from engagement by the notched stem **29** whereby the shackle **8** may move to the position shown in FIG. **7**. The switch **10** is, as a result, opened so that the motor M and the lamp A cease to be supplied with electric current. The massaging action of the finger then stops and since the latter is no longer gripped in the holding means formed by the shackle **8** and the block **6**, the subject can remove his hand from the apparatus.

As can be seen from FIGS. **3** to **7**, the blood collector device **15** is so positioned in the apparatus that it would be particularly difficult for it be extracted from the latter by hand, once full. That is why the extraction operation is here done, at least partially, in a mechanical manner. This is achieved by lifting the shackle **8** into the position shown in FIG. **8** since, in doing so, the pin **8***c* comes to bear on the underface of the lever portion **17***a* and progressively comes to lift lever **17** which in turn gradually lifts the blood collector device out of the casing body **3**, until such time as the lever **17** abuts against the underside of the transverse portion of the mounting **12**.

It will be observed that the underface of lever portion **17***a* has a rounded outline, that the center of curvature of this rounded outline comes to coincide substantially with the pivotal axis **7** of the shackle **8** when the shackle **8** reaches the FIG. **8** position, and that radius of this rounded outline is slightly greater than the distance between the pivotal axis **7** and the oppositely facing surface of the pin **8***c*. Consequently, when the lever **17** is in the FIG. **8** position, there is nothing to prevent the shackle **8** from being swung back further to the position shown in FIG. **9**, this being the same position as the starting position shown in FIG. **2**, and once the pin **8***c* has been raised to a level higher than the tip of lever portion **17***a*, the lever **17** will drop back on to the sliding pin **13**, and the apparatus is then ready for a fresh blood sampling operation.

FIGS. **13** to **16** illustrate a modified constructional form of finger holder. This holder, which also serves to maintain a finger by its tip on a blood collector device and to massage the finger whereby blood is made to flow towards the incisions made in the finger tip, comprises a stirruplike member **41** whose limbs extend through slots (not shown) into the casing **42** of the apparatus where they are pivotally mounted on a pin **43** eccentrically driven by the output shaft **44** of a motor (not shown), and further comprises a swell **45** which is provided on the top surface of the casing **42** between the limbs of the stirruplike member **41** and on which the subject from whom a blood sample has to be taken is meant to put one of his fingers. Underneath the top of member **41** there is provided a pad **46** of synthetic sponge via which member **41** comes to bear on the finger.

The manner in which the finger is massaged as illustrated by FIGS. **13** to **16** wherein the stirruplike member **41** is shown occupying four different positions as a result of the shaft **44** having been rotated each time through 90° in relation to the previous position.

The illustrated apparatus has of course only been given by way of example and a number of other constructional forms could be envisaged. For instance, instead of being portable, as described, and being run off batteries, the apparatus could be designed to be normally static and be adapted to be supplied with electricity off the mains.

Also, different constructed forms of blood collector devices can be used in the illustrated form of apparatus and a number of such devices, in addition to that illustrated in FIG. **11**, have been described and illustrated in our copending Pat. application Ser. No. 843096, filed July 18, 1960, entitled "Blood Collector Device."

We claim:

1. An apparatus for obtaining a percutaneous and digital blood sample from a human finger in conjunction with a blood collector device comprising a tube in the mouth of which is fitted a resilient funnel member fitted with at least one incisor lancet directed towards the open end of the funnel member, said apparatus comprising a housing mounting in said housing, said mounting formed with a through passage in which a tube can be removably inserted, said through passage having a predetermined length and a top and bottom opening; a striker mechanism mounted in said housing and having a releasable striking member facing the bottom opening of said through passage, means for releasing said striking member to propel it toward said bottom opening, said striker member adapted to strike, when released, the inner end portion of a tube, in said through passage, thereby to tend to propel a tube out of said through passage; a clamping means mounted on said housing and adapted to clamp a finger on said housing in line with said top opening of said through passage and means for periodically varying the clamping action of said clamping means whereby at least part of the tissues of a finger in said holder may alternately be constructed and released.

2. Apparatus as claimed in claim **1**, wherein said clamping means comprises a supporting block adapted to support a human finger and a movable shackle adapted to be applied on to the part of a finger opposite to that which is meant to lie on said block, a lever, a motor, an eccentric on said motor, said lever drivingly connected at its one end to said motor through the intermediary of said eccentric and connected at its opposite end to said block, wherein said motor is adapted to rotate in a direction such that said block may be caused to move from the back of a finger towards the front thereof while at the same time compressing the tissues of the finger, and wherein the plane in which the eccentric motion of the block-carrying lever takes place contains the axis of said through passage, the relative positions of said through passage and of said block being such that the bottom opening of said through passage opens in a means plane substantially equidistant from points, along the eccentric path followed by the block, respectively corresponding to maximum and minimum compression of the finger tissues when a finger is placed on said apparatus.

3. Apparatus as claimed in claim **2**, wherein said shackle comprises a lever which is mounted for pivotal movement in said housing in the plane of eccentric motion of said block-carrying lever and at a location opposite to that occupied by said block in relation to said through passage, said shackle being movable between a first extreme position in which it is adapted to be applied to a finger and a second extreme position which is sufficiently far removed from the first to provide free access to said block and to the funnel member of a blood collector device when inserted in said through passage, said apparatus further comprising a means for locking said shackle in said first extreme position and a return member for moving said shackle away from said first position upon being released from the action of said locking means.

4. Apparatus as claimed in claim **3**, including first and second switches and an element on said shackle wherein said motor is supplied with current through at least said first switch adapted to be closed by said element carried by said shackle when said shackle is moved towards said first extreme position, and through at least said second switch controlled by an element adapted to be actuated by a blood collector device when inserted in said through passage to close said second switch.

5. Apparatus as claimed in claim **4**, and further comprising a light source arranged to project a beam of light across said through passage, a photoelectric detector located opposite said source in relation to said through passage to receive said beam after crossing said through passage, a photoelectric detector located opposite said source in relation to said through passage to receive said beam after crossing said through passage, electronic amplifying means controlled by said detector, a relay having a winding armature and core and controlled by said amplifier to actuate said locking means into releasing

said shackle, the arrangement being such that when, during operation, the blood accumulating in a tube reaches a level such that it interferes with the light beam directed towards said detector, said locking means releases said shackle whereby said return member may move said shackle away from said first extreme position to open said first switch and hence stop the motor.

6. Apparatus as claimed in claim 5, wherein the free end of said shackle is provided with to come into meshing engagement least one arm having a saw-toothed longitudinal edge comprising teeth and said locking means comprises a lever which is mounted for pivotal movement between first and second end positions, a return member, said lever having a stem, said lever adapted to be subjected to the action of said return member tending to hold it in said first position and said stem adapted to come into meshing engagement with said teeth on said arm when said lever is in said first end position and said shackle has been moved to said first extreme position, said second end position being such that said stem cannot come into meshing engagement with said teeth on said arm when said lever is in said first end position and said shackle has been moved to said first extreme position, said second end position being such that said stem cannot come into meshing engagement with said teeth, and wherein the lever of said means carries the winding and the core of said relay and further carries the armature of said relay for pivotal movement between a first angular position remote from said core, which it occupies when said winding is not energized, and a second angular position in contact with said core, which it occupies when said winding has been energized, said apparatus further comprising a cam associated with said block-carrying lever, which is so positioned as to come into contact with one end of the relay armature, when said relay has been energized, and which is adapted to move said armature in a direction such as to cause the lever of said mechanism to be rocked into its second end position.

7. Apparatus as claimed in claim 6, and further comprising a manually actuatable push button cooperating with the lever of said locking means and adapted, when pressed, to rock said lever into its second end position against the action of the return member associated therewith.

8. Apparatus as claimed in claim 6 wherein said mounting lies between said block and the pivotal axis of said shackle and is formed with a pair of limbs, and wherein said striking member includes a rocking lever which extends between said limbs, which is pivotally mounted to the side of said mounting furthest from the pivotal axis of said shackle, and which has a projecting free end portion to the side of said mounting nearest the pivotal axis of said shackle, a spring means, said rocking lever freely resting in an inoperative position on a support which is subjected to the action of said spring means tending to return said lever to said inoperative position when it has been moved away therefrom in the direction of the base of said limbs, and wherein the striking lever has a length such that, upon being rocked, the path traveled by the tip of its free end portion may intersect the circular path traveled by an actuating member associated with said shackle when said shackle is about to reach said first extreme position, so that, upon said armature being pivoted from its second extreme position to its first extreme position, said shackle will clock said striking member against the action of said spring means, said cocking action lasting for as long as the respective circular paths traveled by the tip of said free end portion and by said actuating member intersect one another, said striking member being released from the action of said actuating member as soon as these paths cease to intersect one another and then being subjected to the sole action of said spring means which thus propel it towards the bottom opening of said through passage in said mounting.

9. Apparatus as claimed in claim 8, wherein said free end portion has a rounded surface whose center of curvature coincides with the pivotal axis of said shackle when said striking member has been moved into an intermediate position lying between said inoperative position and a position adjacent the rear end of said through passage, the radius of said curvature being slightly greater than the distance between the pivotal axis of said shackle and the portion of said actuating member farthest from said axis.

10. Apparatus as claimed in claim 1, wherein said finger holder comprises a stationary block for supporting the fleshy part of a finger, and a U-shaped shackle having limbs straddling said block on opposite sides thereof and a transverse portion adapted to engage the topside of a finger, said shackle being movable in a plane which is parallel to its limbs and which contains the axis of said through passage, a motor and eccentric and said shackle being drivingly connected to said motor through the intermediary of said eccentric underneath said block whereby it may exert on a finger a pressure during that part of its motion when said eccentric moves away from block and to relax said pressure when said eccentric moves toward said block, the direction of rotation of said motor being such that said shackle is caused to move from the back of a finger towards the front during that part of its motion when it exerts on a finger a compression.

11. An apparatus as claimed in claim 1 wherein said clamping means comprises a finger-supporting block and a movable shackle adapted to be applied onto the part of a finger opposite to that which is meant to lie on said block, a motor mounted in said housing and an eccentric, a lever drivingly connected at its opposite end to said motor through said eccentric, said block being mounted on one end of said lever wherein said motor is adapted to rotate in a direction such that said block is caused to move from the back of a finger clamped in said clamping means towards the front thereof while at the same time compressing the tissues of the finger, and wherein the plane in which the eccentric motion of the block-carrying lever takes place contains the axis of a tube when it is in the said through passage, the relative positions of a tube and of said block when a tube is in said mounting means being such that the rear portion of the tube is adapted to open in a mean plane substantially equidistant from points, along the eccentric path followed by the block, respectively corresponding to maximum and minimum compression of the finger tissues.

12. An apparatus as in claim 1 wherein said clamping means is associated with said means for releasing said striker member whereby said striker means is released when a finger is clamped in place on said housing.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,626,929 Dated December 14, 1971

Inventor(s) Manuel Sanz and George Revillet

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 1 (col. 8, line 6), ", a" should be inserted before "mounting"

(col. 8, line 22), "constructed" should be changed to "constricted"

Claim 2, (col. 8, line 38) "means" should be changed to "mean"

Claim 6, (col. 9, lines 9 & 10) "to come into meshing engagement" should be replaced by "at"

Claim 8, (col. 10, line 1) "clock" should be changed to "cock"

Signed and sealed this 15th day of May 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334