May 27, 1947. W. J. CAMERON 2,421,114

APPARATUS FOR READING BLOOD-PRESSURE AND PULSE

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Fig. 2.

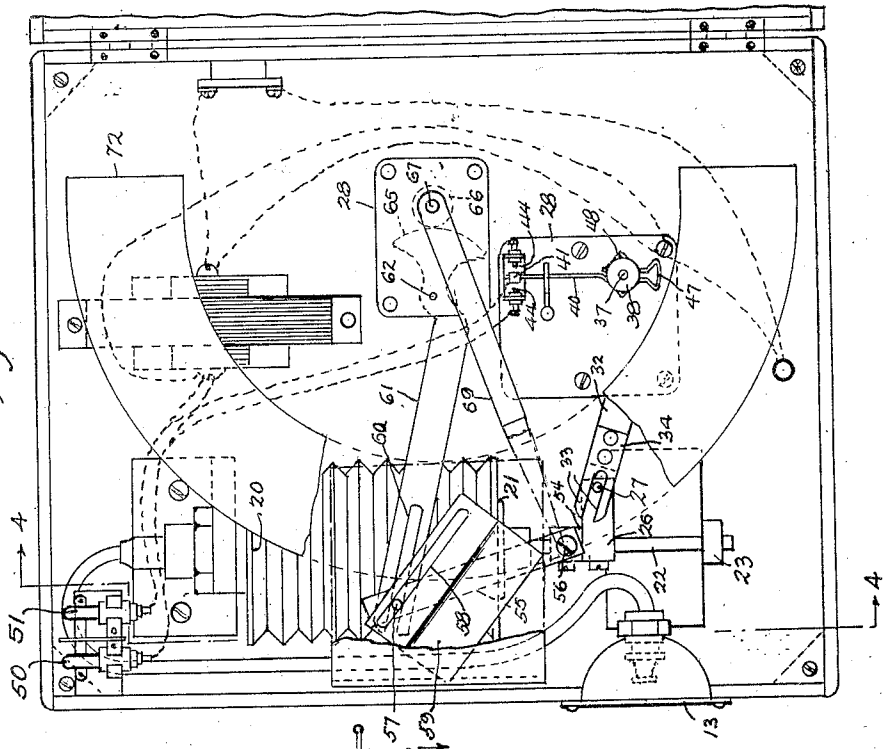
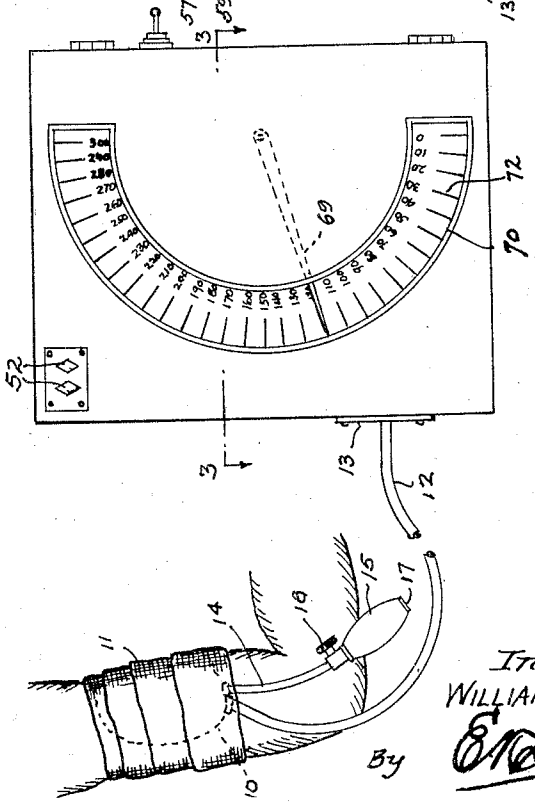


Fig 1



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Fig. 3.

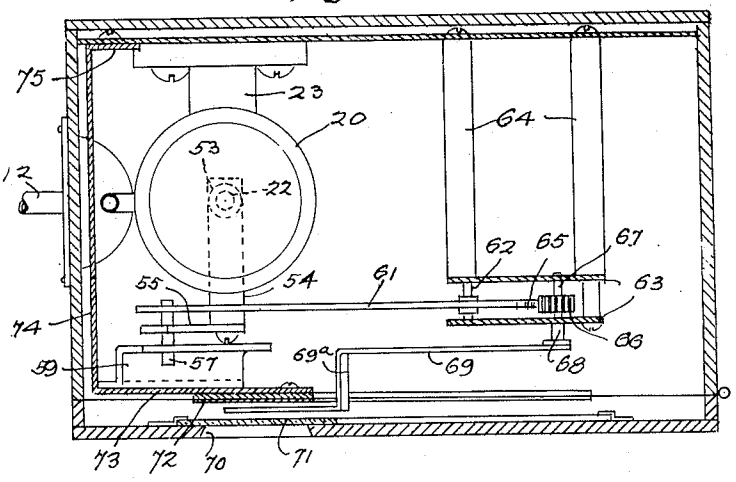
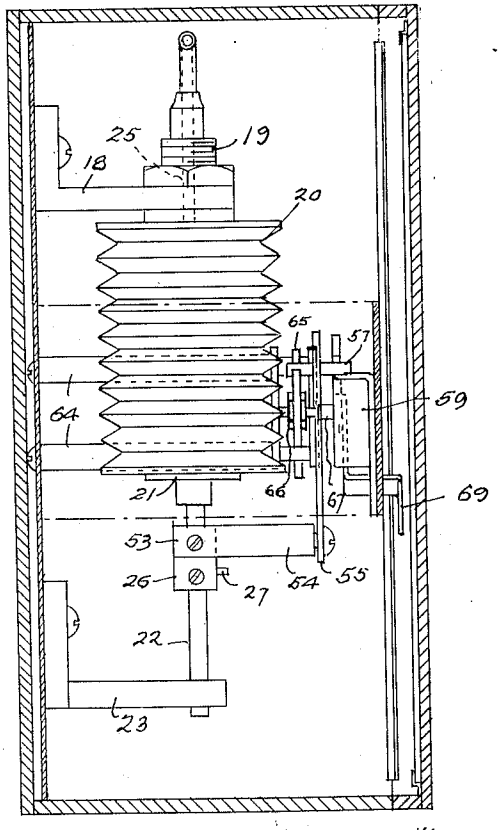


Fig. 4.



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APPARATUS FOR READING BLOOD-PRESSURE AND PULSE

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Fig. 5

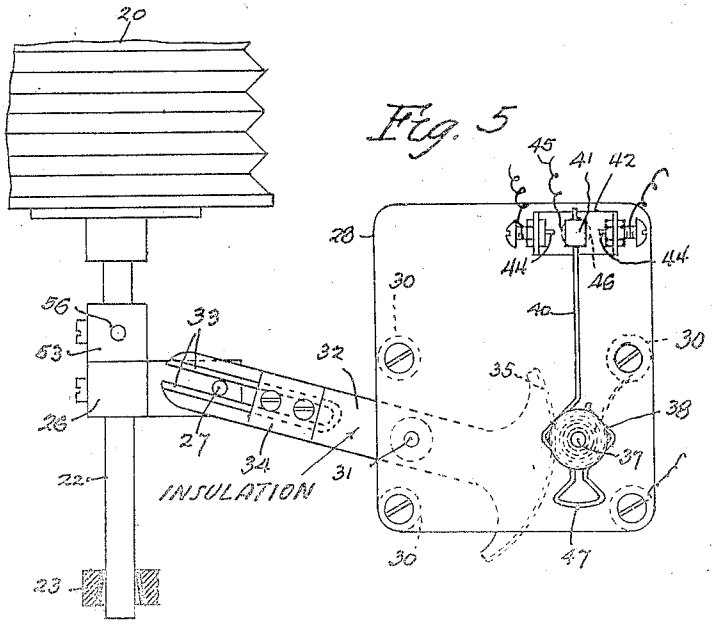


Fig. 6.

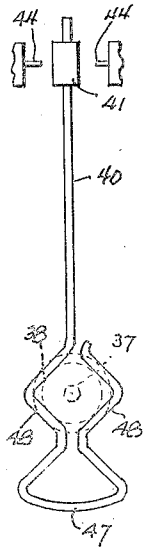


Fig. 7.

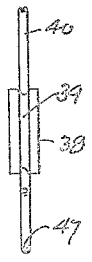


Fig. 8.

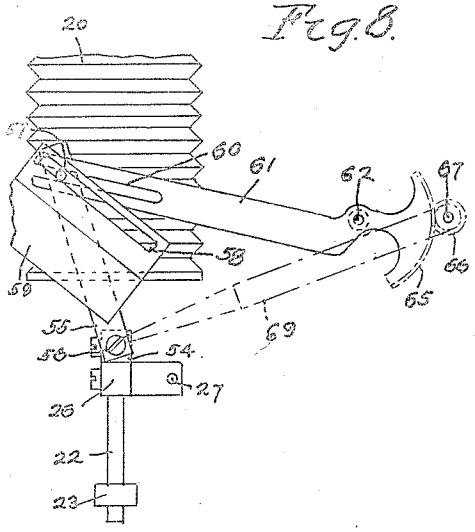
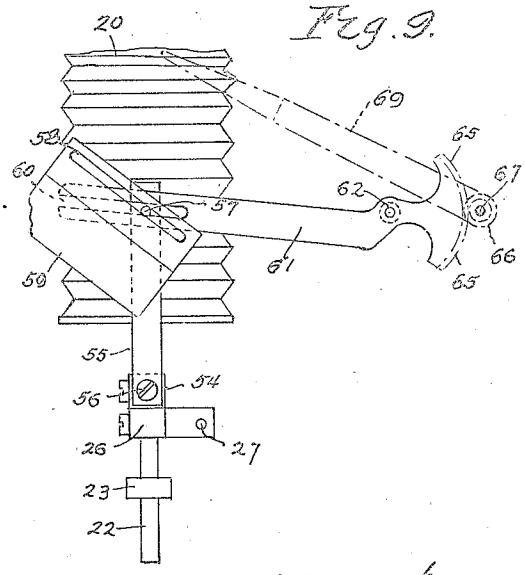


Fig. 9.



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Patented May 27, 1947

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UNITED STATES PATENT OFFICE

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APPARATUS FOR READING BLOOD-PRESSURE AND PULSE

William J. Cameron, Chicago, Ill.

Application October 23, 1943, Serial No. 507,414

7 Claims. (Cl. 128—2.05)

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My present invention relates to an apparatus for readily ascertaining blood-pressures and pulse beats in the circulatory system of persons undergoing physical examination. More particularly the apparatus is designed to ascertain the critical points of systolic and diastolic blood-pressures without the aid of a stethoscope or similar instrument which latter must depend, to a large extent, upon the otic organ of the physician or person making the examination. The apparatus I have invented visually discloses pulsations in the circulatory system through the medium of a target or flashing lamp that is controlled by a surgical arm-band bound upon the patient's arm in which arm-band various pressures are created by means of a valve-controlled collapsible bulb. These pulsations continue between systolic and diastolic pressure but when the critical point of either of these pressures has been reached the pulsations will cease to be noticeable or audible and the target or flashing lamp will stop operation. By means of a chart or scale calibrated with a movable pointer the respective pressures will be indicated and may be easily read by the operator. Even though the operator's hearing may be impaired to the extent that he cannot use a stethoscope, he can with my present apparatus, readily and accurately ascertain the systolic and diastolic blood-pressures and rhythm of the pulse or heart-beats.

The present apparatus which I have invented is extremely small in size so that it may be easily carried by hand from place to place so that a physician may take it to the bed-side of a patient in a residence instead of removing the patient to an examination-room in a hospital or sanatorium, which latter action frequently is not feasible due to the physical condition of the patient.

One of the principal objects of my invention is to provide an apparatus for indicating blood-pressures and pulse beats that dependably operates in the manner herein set forth to accomplish the purposes for which it has been designed. Further objects are to provide an apparatus of novel construction, dependable in operation, made of sturdy parts to withstand hard usage, effective in the performance of its functions, easy to operate, and economical to manufacture so that it may be sold for a reasonable price. Additional advantages and objects will be apparent to persons skilled in the art after my invention is understood from the herein disclosure.

In order to practice my invention and accomplish the objects thereof I prefer to employ a

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structure similar to that herein described and claimed, and for a better understanding of my invention reference is made to the accompanying drawings that form a part of this specification.

In the drawings:

Figure 1 is a front view of my apparatus showing it in use.

Figure 2 is an interior view with the front wall removed.

Figure 3 is a section on line 3—3 of Figure 2 looking in the direction of the arrows.

Figure 4 is a section on line 4—4 of Figure 1 looking in the direction of the arrows.

Figures 5, 6, and 7 are views showing details of the circuit make-and-break device controlling the visual signal.

Figures 8 and 9 are views showing details of the indicator operating mechanism in two positions.

The drawings are to be understood as being more or less schematic in form and for the purpose of disclosing a typical or preferred embodiment of my invention, and in these drawings like reference characters identify like parts wherever such parts appear in the different views.

My apparatus is operated by pressure created in an elastic bag 10 enclosed in a pocket within an elongated fabric ribbon or band 11 that is preferably wrapped around the patient's arm above the elbow. A flexible hose 12 leads from a tubular stub 13 in a wall of a housing to and communicates with the bag 10, and another shorter hose 14 leads from the bag to a collapsible hand bulb 15 having a control valve 16 discharging into hose 14 and having also a valve-controlled inlet 17. By squeezing the bulb 15 pressure is created in the bag 10 which becomes inflated and pressure is thus applied to the brachial artery of the circulatory system. This pressure is conveyed by hose 12 to the pressure-responsive mechanism within the housing or cabinet. Incidentally, it may be here mentioned that the cabinet is a small box-like structure of rectangular shape and formed with walls of insulating material such as a phenolic or resinous condensite which combines both lightness and strength as well as providing a safety factor.

A bracket 18 projecting from a wall of the cabinet is suitably connected to and supports the adjacent end or head 19 of a pressure-sensitive element such as an elastic bellows 20, and the other end or head 21 of said bellows is provided with an axial guide-rod 22 that passes freely through a bearing in a guide-arm 23 secured to and projecting from an adjacent wall of the cabi-

net. The head 19 communicates with the hose 12 through the tubular stub, and said head has a passageway 25 communicating with the interior of the bellows 20. Thus, as pressure is increased or decreased in the bag 10 in the arm-band the bellows 20 is expanded or contracted and the guide-rod 22 is moved up or down. This movement of the rod is translated by suitable intermediaries to the indicating elements of the apparatus.

The guide-rod 22 projects a distance beyond its guide arm 23 as seen in Figures 2 and 4, and near its free end has a collar 26 adjustably mounted on it that has an extension carrying a horizontal pin 27. Adjacent the bellows there is a frame consisting of spaced plates 28 separated from each other by reduced portions on posts 30 that project from a wall of the cabinet. A compositely formed walking-beam lever-arm is fulcrumed intermediate its ends on a rock-pin 31 journaled in the plates 28. A portion 32 of the walking-beam arm is an insulating bar having a U-shaped wire fork 33 adjustably maintained upon its outer end by a clamp plate 34 so that the members of said fork project beyond and engage the pin 27 between them. Said walking-beam lever-arm is thus rocked whenever the bellows guide-rod 22 is moved up or down even the minutest or slightest extent. The other end of this arm opposite the fork has a gear segment 35 secured transversely to it with its teeth meshed with the teeth of a small pinion 36 that is secured fast on a rotatable spindle 37 having its bearings in the plates 28. One end portion of this spindle 37 projects through the plate 28 and has a small friction disk 38 secured to it so that said disk will rotate with said spindle. There is a shallow groove 39 on the edge of the disk which provides an annular friction seat for a portion of an oscillating wire contact arm 40 that extends radially away from the disk and near its free end is provided with a contact element in the form of an embossment 41. A U-shaped bracket 42 is secured to the frame plate 28 near the edge thereof and suitably insulated from said plate. The lateral arms of this bracket, which are disposed respectively upon each side of the contact element 41, are provided upon their facing portions with pin-point contacts 44 that are spaced apart a distance that is sufficient to permit the embossment 41 to move or vibrate between them so as to engage the one and then the other at each end of its movement.

A conductor 45 leads from a suitable source of electrical current to the binding post or screw 46 on the back of frame plate 28 that anchors the U-shaped bracket in position, and the oscillating contact carrying arm 40, with its embossment 41, and the spaced pin-point contacts 44 provide a circuit make-and-break device that operates whenever the bellows is moved the slightest extent. At its lower end the wire arm 40 is bent into a flat spring loop 47 and next to this loop the wire of the arm is bent into opposing right and left angular formations 48 (detailed in Figure 6) that combine to provide a rectangle, one pair of connected adjacent sides of which are urged by the spring loop 47 towards the other pair of connected adjacent sides. These angular sides of the rectangle frictionally fit and tangentially engage the edge groove 39 of the rotatable disk 38 and this friction is sufficient to move the arm and disk together a slight distance to the right or left until the embossment 41 engages one of the pin-point contacts 44. After engagement is

made between one of the contacts 44 and the embossment 41 the disk 38 may continue to turn independently of the rectangle 48 so that the arm 40 will then remain stationary until the disk changes its direction of rotation. Movement of the bellows towards the walking-beam lever-arm 32 will rotate the disk clock-wise to swing the contact arm 40 to the right pin-point contact 44, and the opposite movement of the bellows causes the arm 40 to swing to the left pin-point contact 44.

When the bellows has been partially inflated or expanded so that it responds to beats of the heart, the pulsating movement of the bellows, even though slight, will cause a vibratory movement of the fork 33 and its walking-beam lever-arm, and this back and forth movement is transmitted in amplified form through the segment gear 35 and pinion 36 to the contact-forming vibratory arm 40 so that the embossment 41 will rhythmically touch one and then the other pin-point contacts 44 alternately, thereby illuminating the neon-gas lamps 50 and 51 that are mounted back of windows 52 in the front wall of the cabinet. So long as the attendant or physician observes the alternating flashing of these lamps he is aware of a pulsating pressure in the pneumatic system. The increasing or decreasing of the pressure to a degree where use of a stethoscope would fail to note a pulsation of the heart will cause the vibratory contact arm 40 to come to rest while engaged with one or the other of the pin-point contacts so that only one lamp will burn with steady continuous illumination while the other lamp will be extinguished. Under these conditions the operator will be aware of the fact that the critical point of either systolic or diastolic blood pressure has been attained and will be able to read the degree of pressure in millimeters on the dial or scale now to be described.

The guide-rod 22 of the bellows has a collar 53 secured to it by a set-screw to permit its adjustment longitudinally on said rod independent of the other collar 26, and said collar 53 has an elongated extension 54 projecting horizontally from it to a point beyond the outer periphery of the bellows as shown in Figures 3 and 4. At its outer end this extension 54 carries an upstanding lever 55 that is fulcrumed thereon by a pivot screw 56 which permits said lever to oscillate as shown in Figures 8 and 9 with its free end in front of the bellows. Near its upper free end the upright oscillating lever is provided with a cross-pin 57 that projects through the lever so that one portion of the cross-pin extends towards the front of the apparatus while its other portion extends rearwardly towards the bellows. The forwardly projecting portion of the cross-pin is engaged with and rides in an oblique cam-slot 58 made in an adjacent off-set portion (Fig. 3) of a suitably shaped bracket 59, and the reawardly projecting other portion of this cross-pin is engaged with and rides in forked or bifurcated end portion 60 of a rock-arm 61. This rock-arm, which is substantially horizontally disposed is fulcrumed to swing upon or with a spindle 62 mounted between a pair of vertical frame plates 63 supported by horizontal pillars 64 that are secured to the rear portion of the cabinet.

Thus when the bellows moves the guide-rod 22 in either longitudinal direction the fulcrum 56 of the oscillating lever 55 is correspondingly moved up or down and the cross-pin 57 will cause the rock-arm 61 to move on its pivot 62. The oblique slot 58 which guides the cross-pin causes the

latter to travel in the forked or bifurcated portion 60 of the rock-arm 61 and consequently the cross-pin will move towards or away from the fulcrum of the rock-arm. The purpose of this will presently be explained.

A relatively large segmental gear 65 is formed integral with the portion of the rock-arm 61 that is opposite its forked portion, or said segmental gear may be a separate element suitably secured to the adjacent portion of said arm. The segmental gear 65 meshes with and drives a small pinion 66 suitably mounted for reciprocatory rotary movement and the spindle 67 on which said pinion is mounted is journaled in the frame-plates 63 with an end portion protruding through the front frame plate to afford a rotatable member upon which a small sleeve 68 is frictionally and removably mounted. This sleeve supports an elongated pointer 69 that is disposed immediately back of and substantially parallel to the inner surface of the front wall of the cabinet. The tapered headed end of the pointer is adapted to move in a semi-circular arc back of and visible through a semi-circular slot 70 formed in the front wall of the cabinet. The edges of the slot are preferably chamfered or beveled as shown and a glass plate 71 is secured to the inner surface of the cabinet wall in front of and affording protection to the pointer. There is an off-set portion or elbow 69*a* intermediate the ends of the pointer in order to position its free end immediately back of the glass closure of the curved slot 70. An accurately graduated semi-circular scale or dial 72 is carried upon the arm 73 of an L-shaped bracket 74 that is mounted in the rear portion of the housing or cabinet by means of a lateral flange 75. The bracket 59, in which oblique cam-slot 58 is formed, is also secured to said L-shaped bracket back of the scale or dial, and, as seen in Fig. 3, the free end of the pointer 69 moves between said dial and the glass closure 71.

The operation of the pointer mechanism is as follows: Assuming the pointer to be in the position shown in Fig. 3, the operator creates pressure in the arm band which is immediately transmitted to and causes the bellows to expand thus moving the guide-rod 22 downward. The fulcrum of the oscillating arm 55 is moved downward causing cross-pin 57 to ride downward in the cam-slot 58 while at the same time moving inward toward the fulcrum or spindle 62 of the rock-arm 61. Thus the stroke of the rock-arm is increased correspondingly. This compensates for what might be termed a "retardation" in the normal movement of the bellows. When the bellows has been inflated to a certain degree further inflation sometimes causes a stretching or expansion of the thin metal of which the bellows is formed which increases the tension but decreases the expansibility of the unit resulting in a slowing down of movement and a consequent shortened movement of the pointer. To overcome this possibility arising I have devised the novel compensator mechanism herein disclosed which shifts the rock-arm actuating pin closer to the fulcrum of the pointer so that a shortened downward movement of such pin will accurately swing the pointer with respect to the dial or scale.

What I claim is:

1. A blood-pressure indicator comprising a pressure-responsive element, a reciprocable guide-rod movable with said element, an upstanding oscillating bar supported by said rod, a stud on said bar, a vibratory lever-arm having its fulcrum spaced from said stud, a fork at the free end of said lever-arm engaged with said stud, a pointer, means operatively connecting said pointer to said lever-arm, and cam means adapted to move said oscillating bar during movement of said lever-arm whereby to change the position of said stud with respect to said lever-arm.

2. A blood-pressure indicator comprising a pressure-responsive element, a reciprocable guide-rod movable with said element, an upstanding oscillating bar supported by said rod, a stud on said bar, a vibratory lever-arm having its fulcrum spaced from said stud and having a slotted portion engaged by said stud, a pointer, means operatively connecting said pointer to said lever-arm, and cam means adapted to move said oscillating bar during movement of said lever-arm whereby to shift the position of said stud in the slotted portion of said lever-arm.

3. A blood-pressure indicator comprising a pressure-responsive element, a reciprocable guide-rod movable with said element, an upstanding oscillating bar supported by said rod, a stud on said bar, a vibratory lever-arm having it fulcrum spaced from said stud and having a slotted portion engaged by said stud, a pointer, means operatively connecting said pointer to said lever-arm, and a stationary member provided with a cam surface disposed oblique to the slot in said lever-arm, which said cam surface is engaged by said stud and is adapted to shift said stud in the slotted portion of said lever-arm during movement of the latter.

4. A blood-pressure indicator comprising a pressure-responsive element, a reciprocable guide-rod movable with said element, an upstanding oscillating bar having its fulcrum supported by said rod, a stud on said bar, a vibratory lever-arm having its fulcrum spaced from said stud and having a slotted portion engaged by said stud, a pointer, means operatively connecting said pointer to said lever-arm, and a stationary bracket provided with a cam-slot disposed oblique to the slotted portion of said lever-arm, which said cam-slot is engaged by said stud, whereby movement of said guide-rod due to responsive movements of said pressure-element causes a shifting of said stud longitudinally in said cam-slot and the slotted portion of said lever-arm.

5. A blood-pressure indicator comprising an expandable bellows anchored at one end, a guide-rod secured to and extending from the free end of said bellows, a lateral support projecting from said guide-rod, an upstanding oscillating bar fulcrumed at its lower end on said support, a vertically vibratory lever-arm fulcrumed alongside said bellows and having a slotted portion, a pointer having operative connection with said lever-arm, a stationary plate adjacent said oscillating bar, said plate having a cam-slot disposed in a plane intersecting the plane of the slot in said lever-arm, and a stud on the free upper portion of said oscillating bar, which said stud being engaged in said cam-slot and the slotted portion of said lever-arm, the movement of said bellows and guide-rod being effective to move said bar thereby to change the position of said stud in the slotted portion of said lever-arm.

6. A blood pressure indicator as defined in claim 1, wherein the means connecting the pointer to the lever arm comprises a pinion on the fulcrum of the pointer and a toothed rack on said arm meshed with said pinion.

7. A blood pressure indicator as defined in claim 1, wherein the cam means include an obliquely slotted fixed plate for guiding the stud on the oscillating bar.

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