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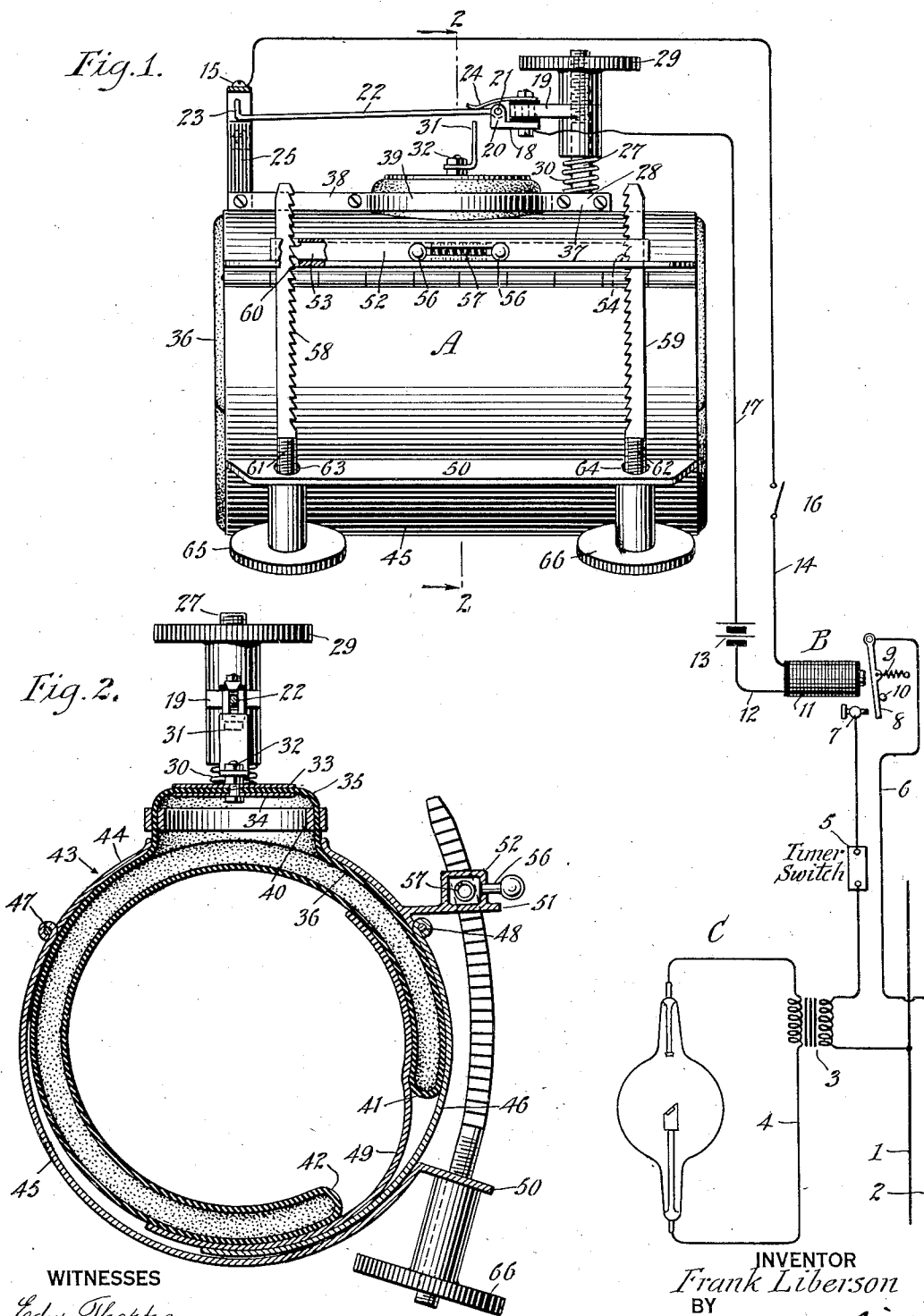
F. LIBERSON

2,017,006

PULSE ACTUATED SWITCH

Filed July 5, 1934

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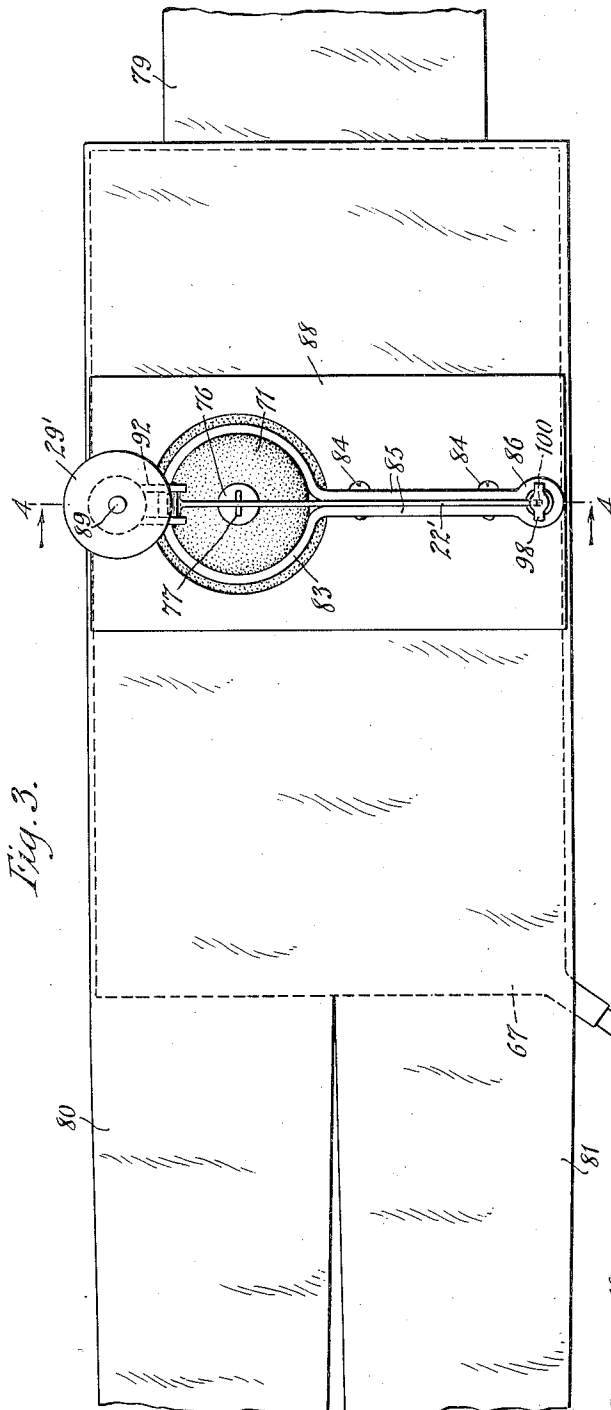
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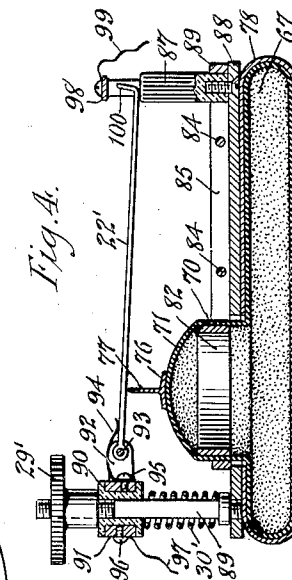
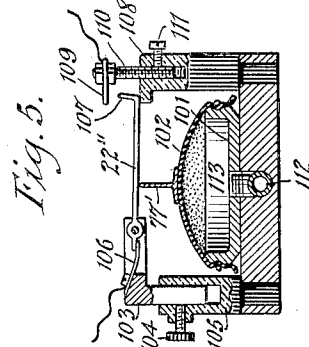
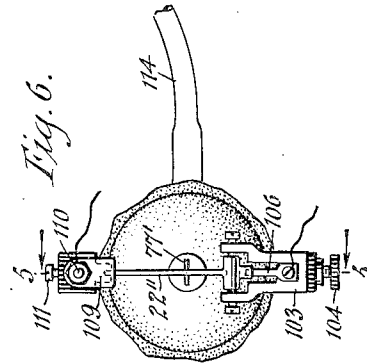
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WITNESSES

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PULSE ACTUATED SWITCH

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4 Claims. (Cl. 200—83)

This invention relates to a pulse actuated device and particularly to a device which includes a switch for closing an electrical circuit whereby certain auxiliary devices may be set into motion, the object being to provide a construction where-
 5 in the auxiliary devices may be set into motion at any phase of the heart beat of a person.

Another object of the invention is to provide an improved pulse actuated switch wherein the parts may be set to be actuated at the begin-
 10 ning, the end, or any intermediate point of a pulse beat.

A further object of the present invention is to provide a device of the character described where-
 15 in the circuit is closed through means actuated by a movement of the pulse, the circuit being operably connected with a secondary circuit for taking X-ray pictures in certain timed relation to the heart beat.

A further object, more specifically, is to provide an improved pulse actuated device operably associated with an X-ray photographic device whereby photographs of the heart may be taken at
 20 any point between the maximum and minimum beat of the heart.

In the accompanying drawings—

Figure 1 is a view partly in side elevation and partly in diagram, illustrating an embodiment of the invention;

Figure 2 is a sectional view through Figure 1 on the line 2—2;

Figure 3 is a top plan view of a slightly modified construction to that illustrated at the upper part of Fig. 1;

Figure 4 is a sectional view through Figure 3 on the line 4—4;

Figure 5 is a sectional view through a modified structure to that illustrated in Figs. 3 and 4, the section being taken on the line 5—5 of Fig. 6;

Figure 6 is a top plan view of the pulse actuated switch shown in Fig. 5.

Referring to the accompanying drawings by reference characters, A indicates an assemblage adapted to be applied to the arm, leg or other part
 45 of a person's body and utilized to transmit the movement of the pulse so as to actuate a switch. Associated with the assemblage A is an electro-magnet switch B which is in the nature of a relay used in closing the circuit of the X-ray machine C.
 50 This machine is to be used in any desired manner but particularly in taking X-ray pictures of other parts of the body or be used for other purposes without departing from the spirit of the invention. It will be understood, however, that

the X-ray machine C is an old and well known device and at present it has been developed so that pictures of the heart or other part of the body may be taken at their highest speed, for instance, with an exposure of one-twentieth of a
 5 second. The circuit and associated parts are well known devices, but for the sake of clearness it may be stated that the wires or conductors 1 and 2 are supply wires supplying current at a desired voltage, for instance, 110 A. C. Current is
 10 supplied to the transformer 3 which steps up the voltage to a desired extent so that the desired voltage may be pressed on the circuit 4. In order to limit the time exposure a timing switch 5 is preferably used in the circuit 6 and is set to
 15 the desired time, for instance, one-twentieth of a second. However, if preferred, instead of using the timing switch 5 which is an old and well known device, a hand switch could be substituted. The circuit 6 includes an adjustable contact 7 coact-
 20 ing with the swinging contact 8, which is held by spring 9 normally against the stop 10.

When the electro-magnet 11 is energized it will act on the swinging contact 8 which is of mag-
 25 netic material and which when attracted by the magnet 11 will swing over and engage the contact 7 against the action of the spring 9. As long as the magnet 11 is energized the circuit 6 will remain closed as far as switch mechanism B is concerned, but may be opened by the timing switch 5.
 30 As a matter of fact, when using the device the timing switch opens the circuit 6 long before the swinging contact 8 is released.

As illustrated particularly in Fig. 1, one side of the coil 11 is connected by wire 12 to one side
 35 of the battery or other source of current 13. The conductor 14 is connected with the other terminal of the electro-magnet 11 and extends to the contact 15, the manually actuated switch 16 being preferably interposed in line. A conductor
 40 17 extends from battery 13 to the contact 18 which is supported upon an arm 19 but insulated therefrom. The contact 18 is provided with an up-standing flange 20 having a pivotal pin 21 car-
 45 ried by the switch arm 22, which arm is preferably provided with a turned up end 23, though this is not necessary. A comparatively light flat spring 24 acts on the switch arm 22 for normally hold-
 50 ing the same lowered, whereby the upper end may rest upon the insulation 25, which insulation supports the contact at 15. The arm 19 is rigidly secured to or formed identical with the tubular
 55 member 26 which member is slidingly mounted on the post 27, said post being rigidly secured to the frame 28. Post 27 on the upper part is

threaded for receiving a nut 29. A spring 30 surrounds the lower part of the post 27 and acts to raise the tubular member 26 and arm 19 while the nut 29 acts to hold these parts down, or to move them down, in order to secure the desired adjustment of the switch arm 22 in respect to the elevating arm 31, which is bolted or otherwise rigidly secured in place. As illustrated in Fig. 2 the bolt 32 extends through an aperture in the arm 31, through the plates 33 and 34, and through the dome 35 of the flexible bag 36. The frame 28 is preferably made in two parts, each part having flat sections 37 and 38 and a semi-tubular section 39. The semi-tubular sections 39 of the respective plates substantially surround the dome 35 approximately midway of the height and clamps the dome 35 against the ring 40 arranged interiorly thereof.

Preferably the frame 28 and ring 40 are formed of metal, though other comparatively rigid materials might be used. The bag 36 may be made from rubber or other flexible or stretchable material which will hold air. When the air pressure increases in the bag 36 it will also increase in the dome 35, and as the central and lower part of the dome are held against expansion, as well as the bag 36, the upper side portions and upper part of the dome will expand upwardly and move the arm 31 upwardly until it strikes the arm 22 and raises this arm against the action of the spring 21. By adjusting the screw 29 the arm 22 may be positioned to cause the arm 22 to move upwardly and strike the contact 15 at the beginning of a heart beat, the end of a heart beat, or any intermediate point. While the end portions 41 and 42 of the bag 36 may expand somewhat, it is preferable that this part of the bag be slightly heavier than the upper part of the dome, so that the most movement will be in the dome to secure the results above mentioned, though the device would operate if all the walls of the bag were of the same thickness, as the movement of the upper part of the dome meets the least resistance when the device is in use.

It will be observed that the bag 36 is adapted to encircle the arm, leg or other part of the body and is prevented from expanding outwardly by the casing 43 which may be of metal or other desired material, and which is formed in several parts, namely, an upper base section 44 and side hinged sections 45 and 46. These latter sections are hinged at 47 and 48 to the base section 44 whereby they may be swung upwardly as shown in Fig. 2 and out of the way when the bag 36 is to be fitted around the arm or other part of the body of the patient. It will be noted that the end 32 of bag 36 is provided with a flexible member 49 which acts as a flap and extends from the upper part of the bag near the end 42, over the inner part of the bag near the end 41, so that the parts may be neatly fitted around the arm. Also, as shown in Fig. 2, the side section 45 is provided with a laterally extending flange 50, while the base 44 is provided with a flange 51, which flange is provided with an elongated housing 52 carrying the sliding catches 53 and 54, as shown in Fig. 1. The housing 52 is provided with a slot 55 through which the respective pins 56 extend. In order that the catches 53 and 54 may be moved toward each other a spring 57 is arranged between the catches and continually urges the same away from each other so that the respective outer ends may project into the racks 58 and 59, which extend through suitable apertures 60 in the flange 51 and the housing 52. The

same racks at the opposite end are rounded and provided with threads 61 and 62 which extend loosely through the apertures 63 and 64 in flange 50, whereby the nuts 65 and 66 may be actuated and flange 51 in order to press the bag tightly against the arm or other part of the body over which it is positioned. Preferably these flanges are brought as closely as possible together by manipulating the same by hand, and then to secure additional pressure the nuts 65 and 66 are operated.

It will be understood that the bag 36 is a completely closed bag and has continually an air or gas pressure therein. This pressure is brought under some tension when the parts are moved to the position shown in Figs. 1 and 2. If it is desired to bring the air under greater tension so as to raise the arm 31, the screws 65 and 66 are actuated thus bringing the air under greater tension. After the parts have been tightly pressed against the arm or other part of the body, the pulse in that part of the body will immediately function to cause a variation in the density of the air in the bag 36 and thereby cause the upper part of the dome 35 to move upwardly and downwardly.

By adjusting the parts to the position shown in Fig. 1, for instance, the switch arm 22 is an appreciable distance above the elevating arm 31. When in this position the device is set to operate at the maximum pulse beat. As the pulse rises the elevating arm 31 will rise and engage the switch arm 22 and raise the same until the end 23 engages the contact 15. In case it should be desired to cause the switch arm 22 to function at the beginning of the pulse movement, the nut 29 is screwed down until the switch arm 22 is substantially in contact with the elevating arm 31, whereby upon movement of the pulse the switch arm 22 will function and close the circuit heretofore described. In this way the X-ray device C may be caused to function and take a picture at the beginning of the pulse or at the end of the pulse. By adjusting the screw 29 to some intermediate position, for instance, where the heart is half expanded, photographs of the heart may be taken at that stage of expansion. Any other intermediate position may be taken by properly adjusting the parts.

While this adjustment is being made the switch 16 is left open as all the other parts are set to instantly take the photograph. As soon as the desired adjustment has been made to take a picture at the beginning, end or some intermediate point of the pulse, the switch 16 is closed and the picture will be taken almost instantly. For the purpose of comparison this is extremely desirable as a picture may be taken at a certain stage of the heart beat, and then placed away until some future time, when another picture may be taken at the same stage of expansion, and by comparison it can be readily ascertained whether or not the heart is enlarged.

While the forms shown in Figs. 1 and 2 are preferable, other forms of the same inventive concept may be used as, for instance, that shown in Figs. 3 to 6, inclusive. In Figs. 3 and 4 the usual inflatable rubber bag 67 is used, the same being provided with the usual bulb pump 68 and valve 69. The bag 67 is of the usual construction except that it is provided with a dome 70 having a partly rounded upper end 71 to which a plate 72 is cemented or otherwise secured, this plate having an upstanding elevating arm 77. A can-

was covering 78 surrounds the bag 67 in the usual way in devices of this kind, said canvas covering having suitable flaps or streamers 79, 80 and 81 which are adapted to be wrapped around the arm or leg to hold the same tightly against the arm when the device is in use so that the movements of the pulse may be transmitted to the air within the bag 67. In order to secure desirable results it is necessary to pump up the bag and then close the valve 69 so that there will be no leakage of air. Consequently the action of the pulse will be readily recorded. A reinforcing ring 82 is arranged within the dome 70 and an encircling frame 83 arranged exteriorly and clamped in place by suitable screws 84 extending through the extensions 85 which are connected together to form the substantially tubular end 86 in which the insulating post 87 is placed, said post being held to the plate 88 by a suitable screw 89. Plate 88 is preferably of metal though it might be of other material and rests flatwise against the fabric casing 78 to which it may be secured if desired by adhesive. A post or standard 89 is screwed into the base plate 88 and carries a spool 90 of vitreous or other insulating material, which in turn carries a bracket 92 having a pin 93 around which the end of the switch arm 22' fits. A spring 94 is held in place by the screw 95 and continually acts to lower the switch arm 22'. A screw 96 acts to connect the wire 97 to the ring 91 so that said wire is in continuous electrical communication with the switch arm 22', and as this switch arm rests normally on the insulated post 87 no current can flow. However, a metal contact 98 is carried by post 87 and to this contact is connected the wire 99, whereby when the switch arm 22' is raised the upturned contact 100 will engage contact 98 and close the circuit to this point. Wires 97 and 99 form part of a circuit similar to that shown in Fig. 1 and are really equivalent to wires 14 and 17 of this circuit, so that when the contact 100 engages contact 98 the electro-magnet 11 will be energized. Aside from the construction just described the action of this form of the invention is the same as that described in respect to Fig. 1, and consequently when the parts have been properly adjusted and caused to function the X-ray device C will be caused to function. In the device shown in Fig. 4 a spring 30' acts in a similar manner to spring 20 shown in Fig. 1, and the nut 29' also acts as the nut 29 in Fig. 1, whereby the switch arm 22' may be raised and lowered so as to be able to take a photograph of the heart at any stage of its expansion.

A further form of the device is shown in Figs. 5 and 6. This is a similar construction but functions in the same manner as the contacts connected up to wires 14 and 17 so that the X-ray apparatus will operate in an identical manner. However, instead of having the bag 36 or the bag 67 as shown in Figs. 2 and 4, a cup of metal or other material 101 is used, and to this is secured an expandable dome 102. An adjustable standard 103 is clamped by a set screw 104 to a suitable insulating post 105, whereby the switch arm 22'' may be adjusted as desired, the spring 106 acting to cause the contact end 107 to remain lowered so that it will rest on the insulating post 103 normally. The contact 109 coacts with contact 107 and is vertically adjustable by reason of the threaded support 110 which may be locked in any desired adjusted position by the set screw 111. In this form of the invention, as well as that shown in Fig. 4, and also as well as that shown

in Fig. 1, the same inventive concept is present, namely, using power from the pulse to close a circuit at a certain time in respect to the various phases of the heart action. Heretofore in taking photographs of the heart the patient was exposed to the X-ray apparatus and a photographic plate, but the operator never knew just what phase of the heart action was being taken, and consequently merely showed the heart fully expanded in one picture, contracted or even half expanded in the others. If a photograph is taken at one time with the heart contracted and a year later with the heart expanded, it might appear as if the heart had been enlarged. Under the present circumstances this would not be the case. By providing means for closing the circuit at any phase of the heart beat so as to instantly take a photograph of the heart at that phase, the physician may readily compare photographs taken at different times and thereby learn whether or not the heart has become enlarged. It will be understood that if the photograph taken at an earlier date was taken with the heart fully expanded, a later photograph should be taken at the same phase of the heart in order to secure a proper comparison. As one method of comparison it is desirable to take a photograph of the heart at its full contraction, a second photograph at its full expansion, and a third photograph at half expansion. With these three photographs taken at a given time, and a similar three taken at a later date, an accurate comparison of the enlargement of the heart may be secured and consequently proper treatment may be prescribed, if treatment is necessary.

I claim:

1. A pulse actuated switch, including a switch arm, means for normally holding the switch arm in an open position, a reciprocating arm adapted to engage and move said switch arm to closed position, a pneumatic bag adapted to be placed around part of the body of a person, means for clamping the bag against the person so that the impulses of the pulse will vary the density of the air in the bag, said bag having a resilient dome adapted to become enlarged as the density of the air in the bag increases, and means for connecting said reciprocating arm to said dome whereby said reciprocating arm is moved back and forth as the dome is actuated.

2. A device of the character described, including an air bag, sealed throughout and formed to be wrapped around the arm, leg or other part of a person, a stiff covering frame in a plurality of parts and hinged together, said covering fitting over said bag, means acting on the covering for constricting the same and pressing the bag against the arm, leg or other part of the body to which it is applied, whereby the pulse will communicate movement to the interior of the bag and vary the density of the air therein, an elevating arm connected with said bag and reciprocated thereby as the density of air therein varies, a contact, a switch arm positioned to be moved into engagement with said contact, said elevating arm being positioned to engage and move said arm into engagement with said contact when the bag is distended to a certain extent, and a spring for moving said switch arm away or from said contact when said bag is deflated to a certain extent.

3. A device of the character described, including a completely sealed bag provided with air under pressure, said bag having a dome, a portion of the dome being free to expand and con-

tract as the density of the air in the bag varies, means for clamping the bag tightly against the arm or leg of the person, a member secured to the top of said dome and caused to reciprocate
5 as the dome moves under the action of the variation in density of the air as the pulse functions, a pivotally mounted switch arm positioned to be engaged by said reciprocating member so as to be moved in one direction thereby, means for
10 moving said arm in the opposite direction, and an adjustable member for varying the pivotal point of said arm in respect to said reciprocating member so as to cause the reciprocating member to actuate said switch arm at any desired
15 stage of the action of said pulse.

4. A device of the character described, including a bag, means for providing air under pressure in said bag, said bag being provided with

a dome having stiff sides and a flexible top adapted to expand and contract as the air in the bag varies in density, a stiff member connected to the center of the top of the dome, said
5 stiff member being adapted to reciprocate as the dome pulsates, a pivotally mounted switch arm, a sliding member for supporting said switch arm, a spring acting on said sliding member to move the switch arm away from the stiff member carried by said dome, and a screw acting
10 on said reciprocating member in the opposite direction to said spring whereby the switch arm may be varied in its position in respect to said dome so as to cause the switch arm to be closed upon the first movement of the dome, the last
15 movement thereof, or any intermediate part of the movement thereof.

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