

July 10, 1956

R. BAILEY

2,753,863

SPHYGMOMANOMETERS

Filed Jan. 7, 1955

2 Sheets-Sheet 1

Fig. 1.

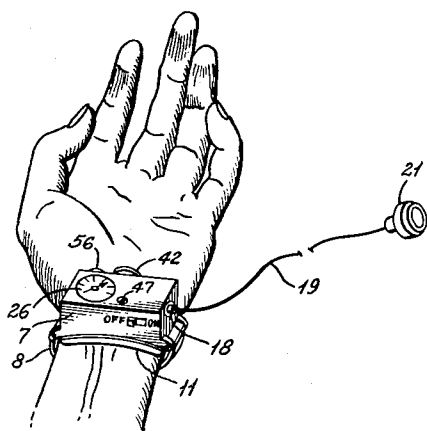


Fig. 4.

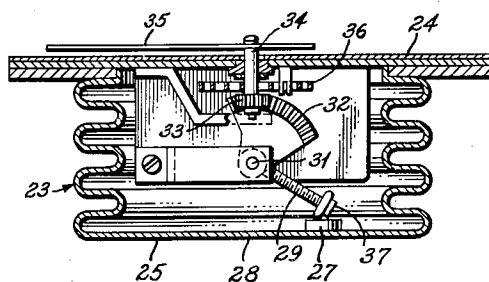


Fig. 2.

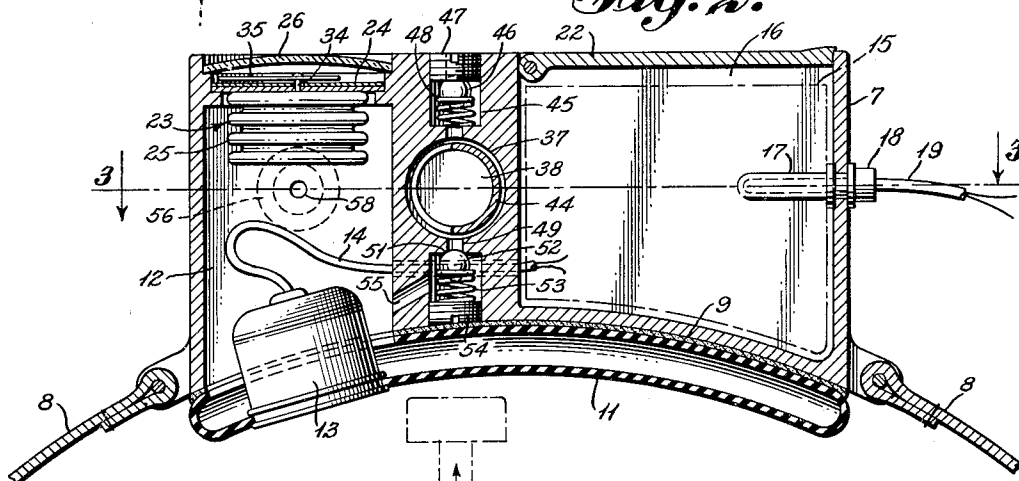
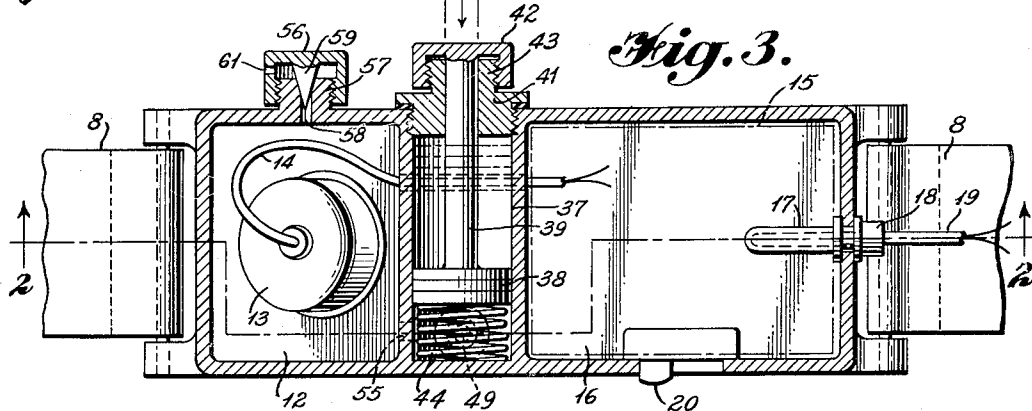


Fig. 3.



July 10, 1956

R. BAILEY
SPHYGMOMANOMETERS

2,753,863

Filed Jan. 7, 1955

2 Sheets-Sheet 2

Fig. 5.

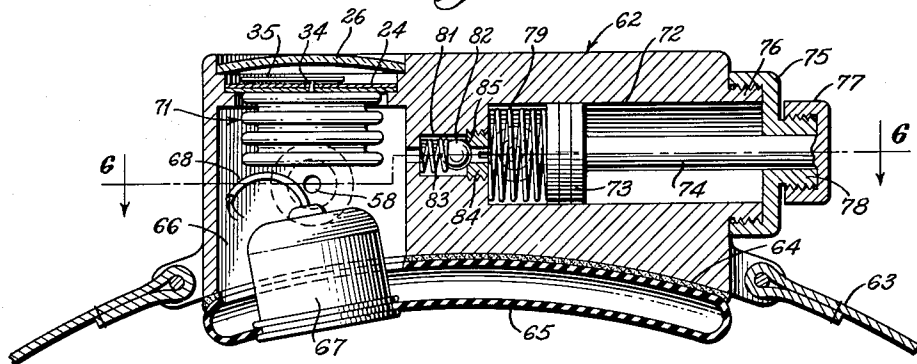
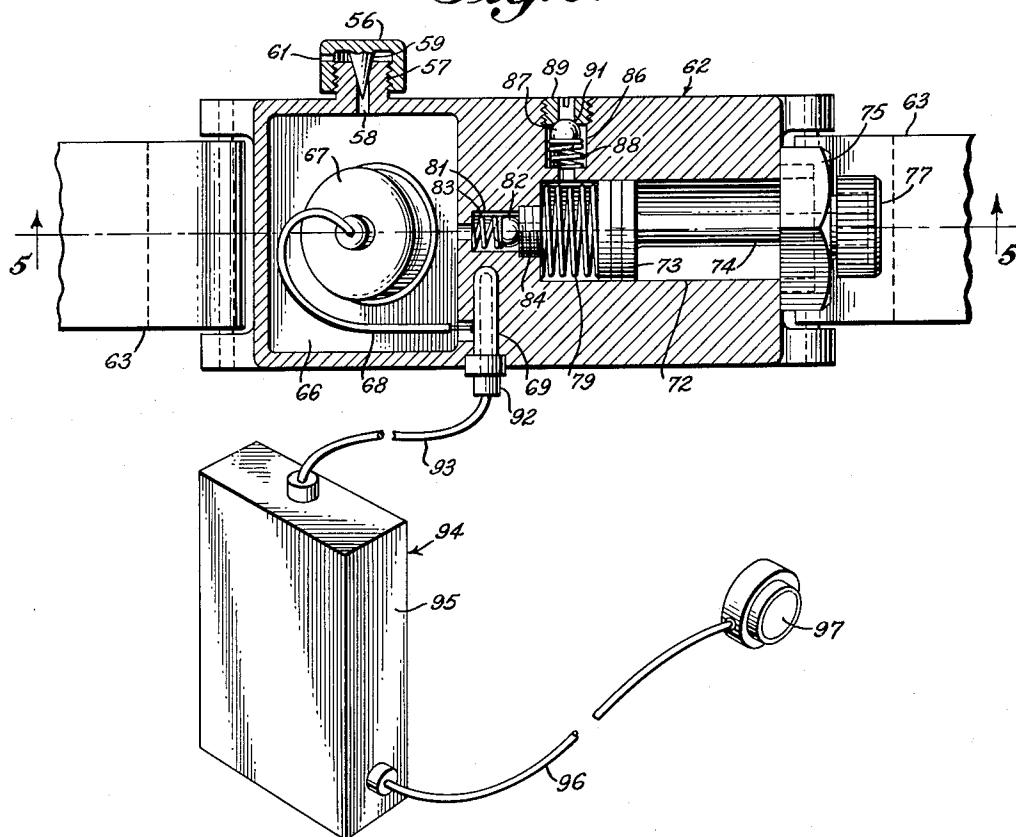


Fig. 6.



1

2,753,863

SPHYGMOMANOMETERS

Ray Bailey, Robinson, III.

Application January 7, 1955, Serial No. 480,438

10 Claims. (Cl. 128—2.05)

This invention relates to new and useful improvements in sphygmomanometers.

In recent years, new medical techniques and drugs have been developed for use in the treatment of hypertension and other types of high blood pressure. Some of these newly developed forms of treatment, however, require a frequent determination of the patient's blood pressure. Since it is often difficult or impossible for the patient to visit his doctor several times a day to have a blood pressure reading, many patients have been instructed by their doctors in the use of the sphygmomanometer and have obtained such an instrument for determining their own blood pressures. Known types of sphygmomanometers, however, are somewhat bulky and necessitate the removal of obstructive clothing so that most patients prefer to use the instrument in the privacy of their own homes. Some patients, therefore, have been required to return to their homes several times a day for this purpose and other patients have resorted to improper or less effective types of treatment to avoid this inconvenience.

It is the primary object of this invention to provide a sphygmomanometer that is compact, completely portable and which includes means for detecting the auscultatory sounds of the human body.

A further important object of the invention is to provide an aneroid type sphygmomanometer which is particularly adapted for self-examination and which may be used at a normally exposed location on the body.

Another important object of the invention is to provide a sphygmomanometer which can be carried and used in an inconspicuous manner to accurately and quickly provide a reliable measurement of the user's blood pressure.

Still another object of the invention is to provide an instrument of this type the manipulation of which requires only one hand so that self-examination is easily and efficiently carried out.

A still further object of the invention is to provide a sphygmomanometer which includes means for detecting and amplifying the pulse beat so that the blood pressure can be accurately determined by a person with little skill or training.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawings forming a part of this specification and in which like reference characters are employed to designate like parts throughout the same,

Figure 1 is a perspective view showing a sphygmomanometer embodying the invention in its operating position on the user's wrist,

Figure 2 is a longitudinal sectional view taken on line 2—2 of Fig. 3,

Figure 3 is a horizontal sectional view taken on line 3—3 of Fig. 2,

Figure 4 is a transverse sectional view of the aneroid gage employed in the invention,

Figure 5 is a longitudinal sectional view taken on line

2

5—5 of Fig. 6, showing a modified form of the invention, and

Figure 6 is a horizontal sectional view taken on line 6—6 of Fig. 5.

In the drawings, wherein for the purpose of illustration are shown the preferred embodiments of this invention, and first particularly referring to Figs. 1 to 3, inclusive, there is shown a housing 7 provided with a strap 8 of flexible but non-resilient material by means of which the housing may be attached to the wrist, as illustrated in Fig. 1, or to any other suitable point on the limb of the user. The housing 7 is provided with a longitudinal concave inner surface 9 and an inflatable pad 11 is cemented or otherwise suitably bonded to this surface. The pad 11 is formed of resilient material so that it will expand in a direction away from the concave surface 9 when inflated. By reference to Fig. 1, it will be readily apparent that the strap 8 will support the housing 7 on the limb of the user in such a manner that the pad 11 is maintained in pressure applying relationship with the associated portion of the limb and that inflation of the pad will cause an increase in the pressure applied to the limb.

At one end of the housing 7 there is provided a chamber or recess 12 which is in open communication with the interior of the pad 11 so that a common pressure will prevail throughout the interior of the pad and the recess. A microphone 13 is mounted on the movable face of the pad 11 and is loosely housed within the recess 12 so that the microphone will be held in contact with the limb of the user by the gas pressure in the pad and the recess. The microphone 13 is a conventional piezo-electric microphone of the type used for general auscultative examinations and is known to the medical profession as a "stethophone."

An electrical conductor extends between and connects the microphone 13 and an amplifying unit 15 which is housed in the chamber 16 of the housing 7. Since the amplifier unit 15 does not form a part of the present invention and since any conventional standardized amplifying circuit may be used, no details of the chassis or components of the circuit have been illustrated. By way of example, however, the amplifier 15 may comprise a circuit such as is conventionally employed in a hearing aid or the like. The conductor 14 is connected to the input side of the amplifier circuit and the output of the amplifier circuit is connected through a plug and jack 17 and 18, respectively, to a conductor 19 which leads to a conventional type earphone 21, as illustrated in Fig. 1. A switch 20 controls the energization and de-energization of the amplifier circuit.

The chamber 16 is provided with a hinged cover plate 22 for access to the amplifier 15 to facilitate repair or replacement of the component parts thereof.

Mounted in the housing 7 is an aneroid type gage 23 having its indicating dial 24 arranged at the outer surface of the housing and its pressure responsive bellows 25 within the recess 12. A transparent crystal 26 overlies the dial 24.

Referring now to Fig. 4 for a detail description of the gage 23, it will be noted that the pressure responsive bellows 25 is arranged for movement in an axial direction as the gas pressure in the recess 12 increases and decreases. This movement of the bellows 25 will cause the lug 27 on the end wall 28 of the bellows to effect pivotal movement of the lever arm 29 about its mounting pin 31. Securely mounted on the pin 31 is an arcuate gear segment 32 which meshes with the pinion 33 on the shaft 34 upon which the pointer 35 is mounted. The shaft 34 is also connected to a spring 36 which urges the shaft into its zero position when the pressures on opposite sides of the bellows 25 are balanced. The le-

ver arm 29 is threaded and is provided with a nut 37 at its outer end portion for engagement with the lug 27 so that the position of the nut may be adjusted to properly calibrate the gage.

Formed in the housing 7 between the chamber 16 and the recess 12 is a cylindrical bore 37 into which is fitted a piston 38 having an operating rod 39 extending outwardly from one side thereof through an opening in the plug 41 that is threaded into the outer end of the bore. A cap 42 at the outer end of the operating rod 39 is internally threaded for cooperation with the threaded lug 43 at the outer end of the plug 41 to retain the piston 38 in its retracted position against the force of a spring 44 positioned between the piston and the inner end of the bore 37. An inlet passageway 45 extends radially outwardly from the inner end of the bore 37 to the outer surface of the housing 7 and is enlarged at its outer end portion for receiving the ball check valve 46 which is urged into sealing engagement with the apertured retaining cap 47 by a light spring 48. The ball 46, therefore, is movable away from the cap 47 to permit air to flow through the apertured cap and the passageway 45 into the inner end of the bore 37 when the piston moves outwardly under the influence of the spring 34. Movement of the piston 38 in the opposite direction, however, will permit the ball 36 to be moved into sealing engagement with the apertured cap 47 by its associated spring 48.

An outlet passageway 49 extends radially outwardly from the inner end of the bore 37 and is shouldered to provide a valve seat 51 for the ball check valve 52 which is urged into its seated position by the spring 53. The spring 53 and ball check valve 52 are retained in their operative positions by a threaded cap 54. A lateral passageway 55 provides communication between the passageway 49 and the recess 12 so that movement of the piston 38 toward the inner end of the bore 37 will compress the air therein and will force the air through the passageway 49, past the ball check valve 52, and through the passageway 55 into the recess 12. It will be readily apparent that the ball check valve 52 will be moved into its closed position by the spring 53 when the piston 38 is moved toward the outer end of the bore 37 by the spring 44.

Operation of the rod 39 to move the piston 38 alternately toward and away from the inner end of the bore 37 will, therefore, cause air to be drawn into the bore through the passageway 45 and expelled from the bore through the passageways 49 and 55 to increase the pressure of the air within the recess 12 and the interior of the pad 11. When the air pump provided by the above described elements is not in use, it is held in its inoperative position by threading the cap 42 onto the threaded lug 43 at the outer side of the plug 41.

A pressure release valve is provided at the side of the housing 7 adjacent the cap 41 by the internally threaded cap 56 which is threaded onto a lug 57 at the side of the housing. A relief passageway 58 extends from the recess 12 through the lug 57 and has fitted in its outer end portion the tapered needle valve member 59 which projects inwardly from the inner surface of the outer end of the cap 56. A radial passageway 61 extends outwardly from the interior of the cap 56 at its outer end portions so that rotation of the cap will cause the needle valve member 59 to permit the controlled escape of gases from the recess 12 through the passageways 58 and 61.

In operation, the above described device is strapped to the wrist or other appropriate spot on the limb of the user. It will be appreciated that the microphone 13 will be positioned over or adjacent to an artery in the limb of the user so that the pulse beat will be properly detected by the microphone. The switch 20 is then moved to its position for energizing the circuit of the amplifier 15 and the earphone 21 is inserted into the ear of the user. The cap 42 is thereafter unscrewed from its latched position on the threaded lug 43 to permit reciprocating movements

of the operating rod 39 to cause air to be pumped into the recess 12 and the interior of the pad 11. This increases the pressure within the recess 12 and pad 11 to cause the latter to be inflated and to exert an increased pressure on the associated portion of the limb of the user. In other words, the pad 11 functions in the same manner as the conventional type tourniquet to restrict the flow of blood at the point of application. Operation of the rod 39 is continued until the pressure increase in the recess 12 and pad 11 is sufficient to indicate to the user through the audible signals of the earphone 21 that the systolic pressure has been reached. The reading of the pointer 35 on the dial 24 is thereupon noted and the cap 42 threaded onto the lug 43.

The cap 56 is thereafter carefully turned to release the gas from the recess 12 and pad 11 at a controlled rate through the passageways 58 and 61. When the pressure within the recess 12 and pad 11 has been reduced to a value at which, as indicated to the user by the audible signals of the earphone 21, the diastolic pressure has been reached, the valve 56 is closed and the position of the pointer 35 on the dial 24 is again noted. The remaining pressure in the recess 12 and pad 11 is thereafter released through the valve 59 and the switch 20 is moved to its off position to de-energize the circuit of the amplifier 15.

When the device is not in use, it will be readily apparent that the plug 18 may be removed from the jack 17 so that the earphone 21 can be conveniently carried while the housing 7 remains strapped to the wrist of the user. Alternatively, the entire unit may be removed from the wrist of the user and carried in a more convenient location until its use is again desired. It will be further apparent that the unit is susceptible of use as above described without the necessity of removing obstructing clothing and that, when in use, the device will remain quite inconspicuous.

Referring now to Figs. 5 and 6 for a detail description of the modification of the invention illustrated therein, reference character 62 designates a housing which is provided with a flexible but non-resilient strap 63 for mounting the housing on the limb of the user. The inner surface 64 of the housing 62 is longitudinally concave and has cemented or otherwise suitably bonded thereto an inflatable pad 65 of resilient material. The interior of the pad 65 is in open communication with a recess 66 in the housing 62 and a microphone 67 is suitably mounted on the movable face of the pad 65 and is loosely housed within the recess 66 so that the microphone will be held in pressure applying relationship with the limb of the user by the gas pressure in the pad and recess. The microphone 67 is of the piezo-electric type as was previously discussed in connection with the microphone 13. An electrical conductor 68 extends between and connects the microphone 67 and a jack 69 at the side of the housing 62.

A gage 71 is mounted in the housing 62 in pressure responsive relationship with the recess 66 to indicate the pressure of gas within the recess and the pad 65. The gage 71 is identical to gage 23 of the previously described modification of the invention and will not again be described, corresponding elements of the gage 71 being given the same reference characters as the corresponding elements of the gage 23.

Formed in the end portion of the housing 62 opposite the recess 66 is a cylindrical bore 72 into which is fitted the piston 73 having an operating rod 74 extending outwardly therefrom through the plug 75 that is threaded onto the lug 76 of the outer end of the bore. The outer end of the operating rod 74 is provided with an internally threaded cap 77 for threadedly engaging the lug 78 of the plug 75 to retain the piston 73 in its innermost position against the pressure of the spring 79 that is positioned between the piston 73 and the inner end of the bore 72.

Extending axially inwardly from the inner end of the

5

6

bore 72 is a passageway 81 having an enlarged portion for receiving the ball check valve 82 and its associated spring 83. The valve 82 and spring 83 are retained in their proper positions in the passageway 81 by the apertured plug 84 which is threaded into the passageway 81 and provides a seat 85 against which the valve 82 is urged by the associated spring 83. It will be readily apparent, therefore, that movement of the piston 73 towards the inner end of the bore 72 will cause the air in the bore to flow past the check valve 82 into the recess 66. Movement of the ball check valve 82 into its seated position by the spring 83, however, will prevent the return flow of gases from the recess into the bore 72. A radial inlet passageway 86 extends from the inner end of the bore 72 to the side of the housing 62 and is provided with an enlarged portion for receiving the ball check valve 87 and its associated spring 88. The valve 87 and the spring 88 are retained in the passageway 86 by an apertured plug 89 providing a valve seat 91 against which the valve is urged by the spring 88. When the piston 73 is moved toward the outer end of the bore 72 air will be drawn into the bore through the passageway 86 past the valve 87 which is moved into its open position against the light pressure exerted thereon by the associated spring 88. Subsequent movement of the piston 73 toward the inner end of the bore 72 will permit the valve 87 to be closed by its spring 88 and will cause the air to be forced into the recess 66 as previously described.

A pressure release valve for the controlled release of gas from the recess 66 is mounted on one side of the housing 62. As illustrated in Fig. 6, this release valve is identical in every respect to the release valve 56 illustrated in Fig. 3 and will not again be described. The same reference characters have been given to corresponding parts of the two valve structures.

Detachably connected to the jack 69 by a plug 92 and cable 93 is an amplifier 94 which is provided with a suitable housing 95. The chassis and electrical components of the amplifier circuit are not illustrated and any of the numerous standard circuits conventionally employed in hearing aids, and the like, may be used. The output side of the amplifier circuit is connected through a conductor 96 to a conventional type earphone 97.

The operation of the device illustrated in Figs. 5 and 6 is identical with that of the modification of the invention illustrated in Figs. 1 to 4, inclusive, except that the amplifier 94 is connected to the microphone 67 by inserting the plug 92 into the jack 69 before the previously described operation is carried out. The remainder of the operation, being identical to that of the previously described modification of the invention, will not again be described.

It is to be understood that the forms of this invention herewith shown and described are to be taken as preferred examples of the same, and that various changes in the shape, size, and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described the invention, I claim:

1. A sphygmomanometer, comprising a housing having a surface with a recess therein, an inflatable pad mounted on said surface in communication with said recess, means for maintaining said pad in pressure applying relationship with a human limb, means mounted in said housing for introducing air into said pad and said recess, means for the controlled release of air from said pad and said recess, means mounted in said housing for indicating the pressure of the air in said pad and said recess, means associated with said pad for detecting auscultatory sounds of the associated limb, and means for amplifying the sounds detected by said sound detecting means.

2. A sphygmomanometer, comprising a housing having a concave inner surface with a recess therein, an inflatable

pad mounted on said surface in open communication with said recess, a strap connected to said housing for mounting said housing on a human limb with said pad in pressure applying relationship with the limb, a pump mounted in said housing for introducing air into said pad and said recess, a valve carried by said housing and communicating with said recess for the controlled release of air from said pad and said recess, an aneroid gage mounted in said housing for indicating the air pressure in said pad and said recess, means associated with said pad for detecting auscultatory sounds of the associated limb, and means for amplifying the sounds detected by said sound detecting means.

3. A sphygmomanometer, comprising a housing having a surface with a recess therein, an inflatable pad mounted on said surface in communication with said recess, means for maintaining said pad in pressure applying relationship with a human limb, means mounted in said housing for introducing air into said pad and said recess, means for the controlled release of air from said pad and said recess, means mounted in said housing for indicating the pressure of the air in said pad and said recess, a microphone carried by said pad for detecting and responding to the auscultatory sounds of the associated limb, an amplifier electrically connected to said microphone for receiving and amplifying the responses of said microphone to said auscultatory sounds, and means for converting said amplified responses to an audible signal.

4. A sphygmomanometer, comprising a housing having a concave inner surface with a recess therein, an inflatable pad mounted on said surface in open communication with said recess, a strap connected to said housing for mounting said housing on a human limb with said pad in pressure applying relationship with the limb, a pump mounted in said housing for introducing air into said pad and said recess, a valve carried by said housing and communicating with said recess for the controlled release of air from said pad and said recess, an aneroid gage mounted in said housing for indicating the air pressure in said pad and said recess, a microphone carried by said pads for detecting and responding to the auscultatory sounds of the associated limb, an electrical amplifier connected to said microphone for amplifying the responses of the latter to said auscultatory sounds, and an earphone electrically connected to said amplifier for converting said amplified responses to an audible signal.

5. A sphygmomanometer, comprising a housing having a surface with a recess therein, an inflatable pad mounted on said surface in open communication with said recess, a strap connected to said housing for mounting said housing on a human limb with said pad in pressure applying relationship with the limb, a pump mounted in said housing for introducing air into said pad and said recess, a valve carried by said housing and communicating with said recess for the controlled release of air from said pad and said recess, an aneroid gage mounted in said housing for indicating the air pressure in said pad and said recess, means associated with said pad for detecting and responding to the auscultatory sounds of the associated limb, means mounted in said housing for amplifying the responses of said sound detecting means, and means for converting said amplified responses to an audible signal.

6. A sphygmomanometer as defined in claim 5 further characterized by said sound detecting means comprising a microphone mounted on said pad for movement therewith to maintain the microphone in sound detecting relationship with the associated limb when said pad is inflated to increase the pressure applied to the limb by the pad.

7. A sphygmomanometer as defined in claim 6 further characterized by said microphone being of the piezo-electric type, said amplifying means comprising an electrical circuit connected to the microphone, and said converting means comprising an earphone electrically connected to said amplifying circuit.

8. A sphygmomanometer, comprising a housing having

7

a surface with a recess therein, an inflatable pad mounted on said surface in open communication with said recess, a strap connected to said housing for mounting said housing on a human limb with said pad in pressure applying relationship with the limb, a pump mounted in said housing for introducing air into said pad and said recess, a valve carried by said housing and communicating with said recess for the controlled release of air from said pad and said recess, an aneroid gage mounted in said housing for indicating the air pressure in said pad and said recess, means associated with said pad for detecting and responding to the auscultatory sounds of the associated limb, an amplifier detachably connected to said sound detecting means for receiving and amplifying the responses of the latter, and means associated with said amplifier for converting said amplified responses to an audible signal.

9. A sphygmomanometer as defined in claim 8 further characterized by said sound detecting means comprising a microphone mounted on said pad for movement there-

8

with to maintain the microphone in sound detecting relationship with the associated limb when said pad is inflated to increase the pressure applied to the limb by the pad, said microphone being connected to said amplifier through detachable connecting means located in said housing.

10. A sphygmomanometer as defined in claim 9 further characterized by said microphone being of the piezo-electric type, said amplifier comprising a separately housed electrical circuit, said connecting means comprising a plug and socket, and said converting means comprising an ear-phone electrically connected to said amplifier.

References Cited in the file of this patent

UNITED STATES PATENTS

2,074,520 Snyder Mar. 23, 1937

FOREIGN PATENTS

42,276 France June 21, 1933