April 25, 1967 M. A. BUFFINGTON 3,315,662

OSCILLOMETRIC MONITORING SYSTEM FOR SPHYGMOMANOMETERS

Filed Jan. 16, 1964

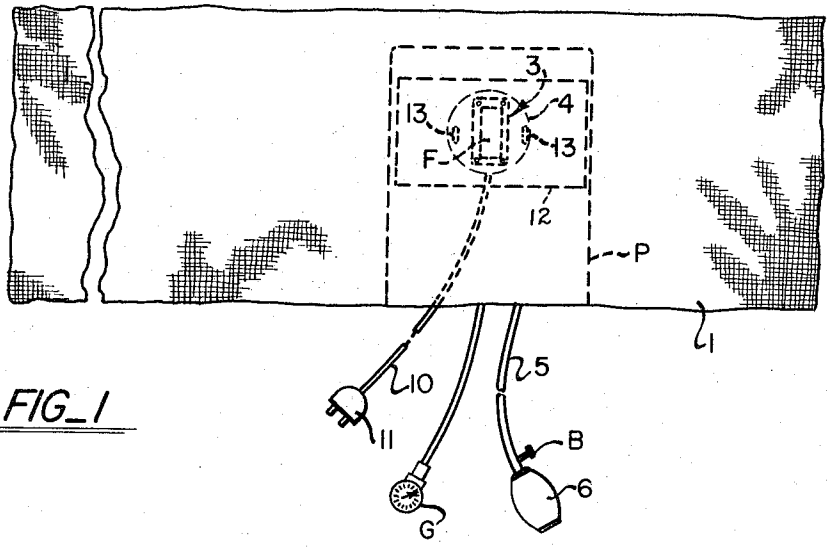


FIG_1

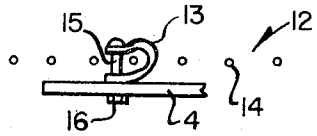


FIG_3

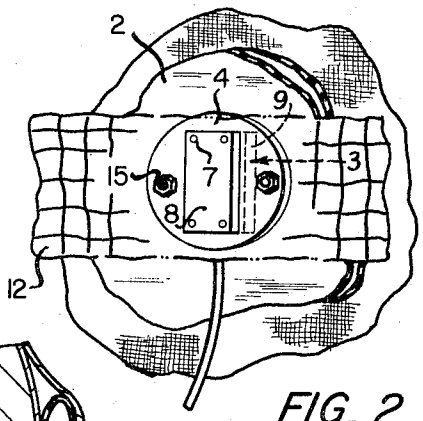


FIG_2

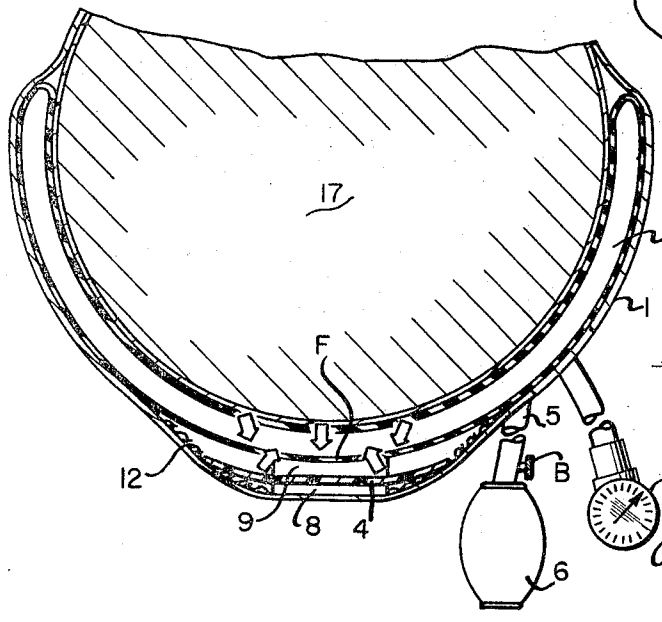


FIG_4

INVENTOR.
MARVIN A. BUFFINGTON
BY
Oberlin, Maky & Donnelly
ATTORNEYS

United States Patent Office 3,315,662
Patented Apr. 25, 1967

3,315,662

OSCILLOMETRIC MONITORING SYSTEM FOR SPHYGMOMANOMETERS

Marvin A. Buffington, 1061 Lauder Road, Cleveland, Ohio 44124

Filed Jan. 16, 1964, Ser. No. 338,240
7 Claims. (Cl. 128—2.05)

This invention is directed to an ultrasensitive sphygmomanometer monitoring system of the oscillometric type. This invention particularly relates to such a system wherein a novel electronic oscillometric cuff is employed.

This invention can best be understood by distinguishing between the basic monitoring systems used in present medical practice. The auscultatory system employs the principle wherein a device detects sounds which are produced within the body by the circulation of the blood and uses these sounds as a means of detecting blood pressure in conjunction with a sphygmomanometric cuff. Determination of blood pressure is made by inflating the cuff so as to ascertain the blood pressure as the cuff pressure is released by listening to the returning sounds. Specifically the oscillometric technique utilizes the pulse indication generated in the inflatable bag and manometer of the sphygmomanometric system. By means of the electronic system in the cuff which detects the pulse of the arterial system of the body, pulse indications are generated at all pressures in the cuff and come to a peak at the mean arterial value.

The oscillometric technique is presently employed in medical practice in tests for pulse values in various parts of the body for determining arteriosclerotic conditions and in testing for a basal pulse in critical or surgical patients when an ordinary blood pressure cannot be obtained by the auscultatory method.

The present oscillometric systems, however, have not been used as extensively in medical practice as desired because of the inability of such mechanical systems to provide a significant pulse indication on the present read out means. This inability is a direct result of the fact that the presently available sphygmomanometers do not possess a sufficiently high degree of sensitivity at low cuff pressures.

It is an object of this invention therefore to provide an ultrasensative oscillometric device whereby the above-mentioned problem of the prior art is avoided.

Another object of this invention is the provision of an ultrasensitive sphygmomanometer wherein an electronic oscillometric cuff of a special design is utilized.

Other objects, features, and advantages of this invention will become apparent to those skilled in the art in view of the following more detailed description of the invention.

These and other objects are achieved by means of this invention in which an ultrasensitive electronic means is provided for observing pulse in the sphygmomanometric system. Specifically, the electronic means comprises a fabric cuff of the Tycos type which has an inflatable bag member positioned therein and a transducer element inserted within the cuff and against the face of the inflatable bag. The transducer element has a flexible focusing disc attached to it which serves, as will be more fully explained, to give the transducer an increased degree of sensitivity.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail a certain illustrative embodiment of the invention, this being indicative, however, of

but one of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

FIG. 1 of the drawings is a fragmentary plan view showing schematically the electronic sensing device inserted into the cuff of a sphygmomanometer;

FIG. 2 is a fragmentary perspective view showing in detail the parts of the electronic sensing device and its relationship relative to the inflatable bag and cuff, which is illustrated broken away;

FIG. 3 is an enlarged fragmentary detail view showing the connection between the focusing disc and the flexible grid; and

FIG. 4 is a fragmentary view showing, in cross section, the sphygmomanometer of this invention in operative position on an extremity of the body.

Referring now to FIG. 1, the numeral **1** designates a fabric sphygmomanometric cuff with a pocket P formed therein. Broken lines **3** and **4** show the transducer element and flexible disc member respectively of the electronic sensing device positioned within pocket P. Numeral **10** designates a cable which is connected to the transducer element **3** and which has an electrical connector **11** thereon which is capable of being operatively attached to an observational medium (not shown) such as an electrocardiograph, a cardiac monitor, or an electronic meter of any of the many varieties presently available. Also shown in FIG. 1 is a pressure tube **5** with standard valve means B and bulb member **6** attached thereto which is connected to the fabric cuff and the inflatable bag member therein for creating pressure within the cuff and bag during the operation thereof. The usual gauge means G is also shown connected to cuff **1** for observing the blood pressure.

In FIG. 2, the numeral **2** designates the inflatable bag member positioned within the cuff **1**. Transducer element **3** is positioned with its face in contact with the face of inflatable bag **2**. A thin flexible focusing disc **4** (made from any flexible plastic such as polyethylene or similar material) is positioned between the face plate and back-up plate of the transducer element. Focusing disc **4** is attached to the transducer by means of fasteners such as machine screws and nuts, which are illustrated on the drawings at **7**. Such fasteners **7** extend through the back-up plate **8** of the transducer. The disc **4** may then be sandwiched between the main body **9** and the back-up plate **8** of the transducer. In this manner, a disc **4** can be attached to a conventional sensitive electronic pressure transducer which may be of the piezo electric type so that the main body **9** thereof containing the sensitive face F will be substantially centered on the disc.

Referring now additionally to FIG. 3, focusing disc **4** is also attached to a flexible locating screen or grid **12** by a plurality of flexible tab members **13** which are wrapped around bars **14** of the grid **12** and fastened with round head machine screws **15** and nuts **16** thereto. The distal ends of the tabs **13** may be provided with button-holes which snap over the round heads of screws **15** releasably to secure the grid to the disc. As indicated, two diametrically opposite tabs **13** are provided on each side of the disc, although further such fasteners may be provided.

Grid **12** is preferably made of nylon, but can be of any suitable resilient plastic material. As shown, grid **12** extends laterally beyond focusing disc **4** and transducer element **3**. The function of the grid is to standardize the position of the disc and the transducer within cuff **1** without being fastened thereto, the grid being rolled up or wrapped around the transducer prior to insertion in pocket P and unrolled after insertion therein.

In FIG. 4, the cuff 1 is shown in cross section posi-
oned on an extremity of the body 17 such as an arm,
g, etc. as the case may be. The inflatable bag 2 is
ositioned such that it is adjacent the extremity 17 and
eparated therefrom only by fabric cuff 1, with the
ansducer element 3 in contact with the inflatable bag
n the side thereof opposite that in contact with the
xtremity. In this view, the bag 2 is inflated (by the
ulb member 6) thereby forcing flexible disc 4 to
ex, as indicated to a concave form. When disc 4
s in this position, it will cause the pulse waves (indi-
ated by the arrows in FIG. 4) which are emitted from
xtremity 17 through inflatable bag 2 to be reflected by
he flexed disc 4 back against the inflatable bag and
ransducer element 3 thereby focusing the pulse waves
gainst the transducer element and increasing the pick-up
ensitivity thereof.

The oscillometric system described above operates as
ollows. The sphygmomanometric cuff 1 is wrapped
round an extremity of the body 17 in the manner illus-
rated in FIG. 4. The electrical connector 11 which
s attached to cable 10 of the transducer is connected to
a suitable observational medium, not shown. The in-
flatable bag 2 is then pumped up through bulb 6 and
pressure tube 5 to a suitable pressure. Since the trans-
ducer element 3 is in contact with the inflated bag 2, and
since focusing disc 4 is in its flexed position, the transducer
detects the pulsations and transduces them into electri-
cal energy. This energy is introduced into the observa-
tional medium and amplified therein so that the pulsa-
tions, which are usually seen as small deflections in the
usual oscillometric technique, are now displayed on the
observational medium as large or delineated pulsations
as desired to such an extent that the pulsations can be
classified as to characteristics diagnostically or measured
to be used as a coefficient of quantitative blood pressure
at any cuff pressure.

It is thus seen that the present invention, as described,
provides an ultrasensitive electronic oscillometric system
for detecting pulsations which utilizes existing medical
techniques, merely being adapted to the existing syhyg-
momanometric system, without inhibiting or altering the
existing equipment.

Numerous advantages in the form of new practical
and badly needed clinical techniques are derived from
the ultrasensitive monitoring system of the present in-
vention. It is now possible to undertake precise quanti-
tative and qualitative evaluations of circulatory defects
and qualities in all types of patients. Second, the pres-
ent invention provides a means of determining a type
of blood pressure in an infant or small child which has
not heretofore been clinically practical. Third, the oscil-
lometric system herein described provides a means for
detecting pulse per se in the critical or questionable case
when a blood pulse is not detectable in the usual ausculta-
tory manner. The present invention also provides a
simple and practical oscillometric technique for moni-
toring surgery on arterial graphs and blocks, as well
as for determining oscillometric (mean arterial) blood
pressure for critical and anesthetic usage. The oscillo-
metric system described also makes it possible to deter-
mine a type of blood pressure on animals such as dogs
and cats upon which it is not practical to use a stetho-
scope. In addition to the above advantages, the moni-
toring system described establishes a method for pro-
viding the continuous blood pressure by an oscillometric
system where in a measured pulse amplitude is used as a
coefficient of systolic blood pressure at low cuff pressures
such as 20 millimeters of mercury which can be tolerated
for longer periods of time than usual.

Other modes of applying the principle of the inven-
tion may be employed, change being made as regards the
details described, provided the features stated in any of
the following claims, or the equivalent of such, be
employed.

I, therefore, particularly point out and distinctly claim
as my invention:

1. Apparatus for monitoring vascular pressure varia-
tions, comprising constricting means encircling a portion
of a vascular subject, said constricting means comprising
a retaining member, an inflatable bag member within
the retaining member and means for inflating the inflata-
ble bag member,

a transducer element positioned within said constricting means between the bag member and the retaining member and responsive to fluid flow variations to emit a signal proportional thereto,

a focusing element positioned adjacent said transducer element on the side of said transducer element remote from the inflatable bag for reflecting energy from the flow variations to said transducer element, and

indication means operably connected to said transducer element and responsive to signals emitted therefrom to provide an indication of the fluid flow variations.

2. Apparatus as set forth in claim 1 wherein said
focusing element is flexible and is affixed to said trans-
ducer element whereby said focusing element attains a
concave curvature upon inflation of the bag member.

3. Apparatus for monitoring vascular pressure varia-
tions, comprising

a cuff with an inflatable bag member positioned therein, said cuff adapted for encirclement about a portion of a cardiovascular subject to restrict the flow of blood in such portion when the bag member is inflated,

a transducer element positioned within said cuff against the side of the inflatable bag remote from the subject, and

a focusing disc in abutment with said transducer element on the side of said element remote from the bag member to reflect pulse energy from the variations in blood flow to reinforce the pulse energy affecting said transducer element.

4. Apparatus as set forth in claim 3 wherein said
transducer element is an electronic pressure transducer
which produces an electrical signal in response to defor-
mation caused by variations in blood flow.

5. Apparatus as set forth in claim 4 wherein said
focusing disc is a thin disc of flexible material which
assumes a concave curvature when the bag member is
inflated to provide a focused reflective surface for blood
pressure waves.

6. Apparatus as set forth in claim 5 further including
a grid attached to said focusing disc to retain said focus-
ing disc in position within said cuff.

7. Apparatus as set forth in claim 6 wherein said disc
has flexible tab members for releasably securing said
grid to said disc.

References Cited by the Examiner

UNITED STATES PATENTS

1,089,122	3/1914	Faught et al.	128—2.05
2,405,265	8/1946	McAlpine	128—2.05 X
2,896,610	7/1959	Speelman	128—2.05
3,239,696	3/1966	Burkhalter	128—2.05 X

RICHARD A. GAUDET, *Primary Examiner.*

SIMON BRODER, *Examiner.*