Dec. 11, 1962 J. BODENGER 3,067,833

STETHOSCOPE

Filed June 22, 1960

FIG. 1.

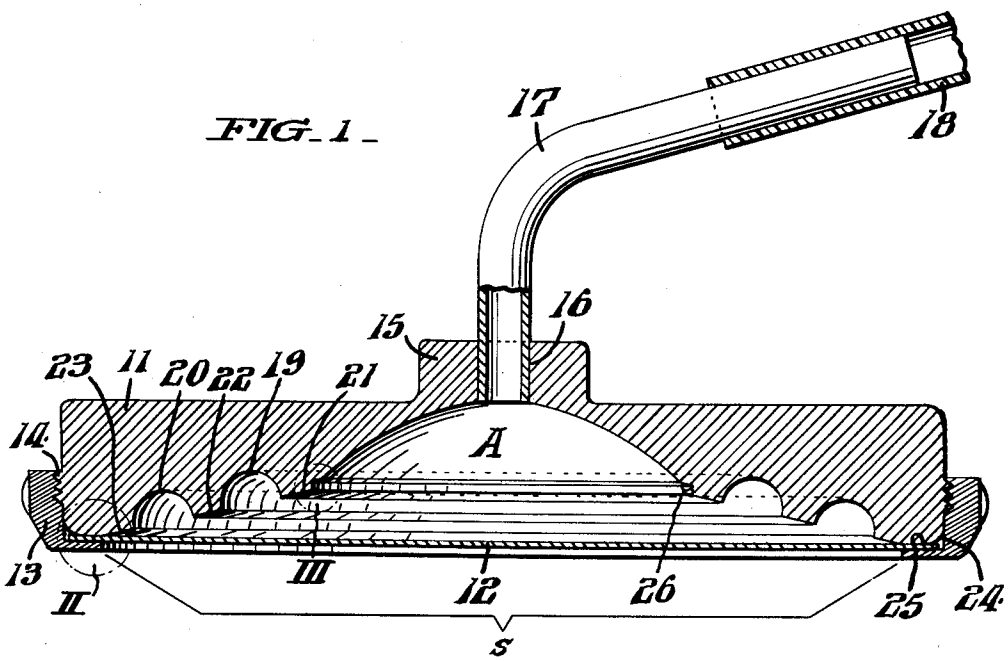


FIG. 3.

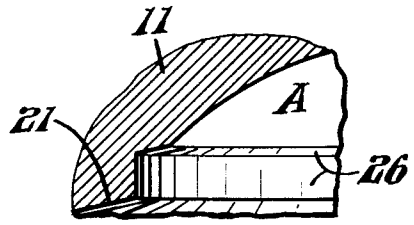


FIG. 2.

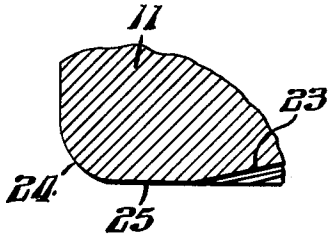
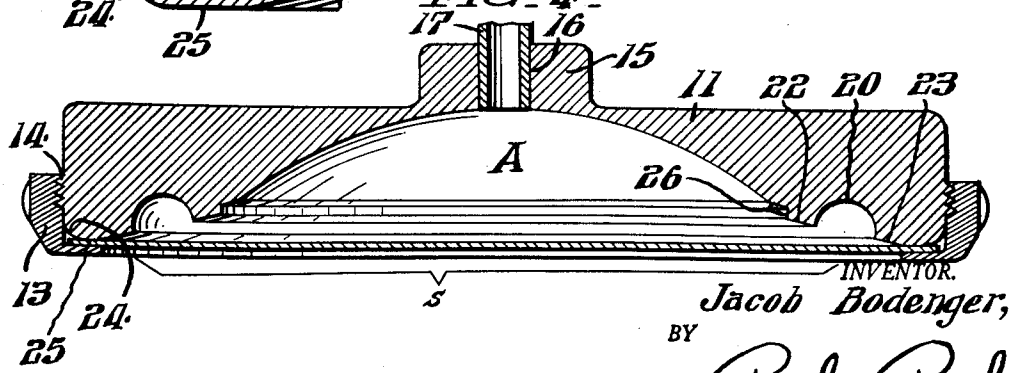


FIG. 4.



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STETHOSCOPE

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5 Claims. (Cl. 181—24)

This invention relates to stethoscopes utilized in medical diagnosis, and more particularly it relates to a novel stethoscope chest piece having greatly improved characteristics.

For the investigation of a variety of normal and abnormal sounds produced within the human body, the physician relies in large measure upon listening to these sounds with the ordinary stethoscope. Of particular importance are the characteristics of the normal heart sounds, heart murmurs, normal breath sounds, and rales. The presence of any one of several types of lesions in or near the valves of the heart gives rise to eddies in the blood current which result in abnormal sounds known as murmurs. Such murmurs are important in the diagnosis of several conditions such as, for example, mitral stenosis, which is a narrowing of the left atrioventricular orifice. Rales are those sounds produced by the passage of air through portions of the bronchial tree which have been narrowed or which contain fluid and debris.

All the aforementioned sounds consist of mixtures of tones of different frequencies and intensities. Each sound consists of the fundamental tone, which is the note of lowest pitch, and a number of higher-pitched tones called the overtones. The tonal quality of a sound is determined by the numbers of overtones present, their frequencies, and their relative intensities. Generally, the more overtones present the richer the tone color or tone quality. To reproduce sound faithfully, an instrument must be capable of transmitting all frequencies involved and at adequate intensity.

It is known that the standard stethoscope does not transmit all sound frequencies and cannot amplify sound. Therefore it cannot transmit all overtones and cannot faithfully reproduce the sounds which come from the heart and lungs, in all their natural color. For this reason, the conventional stethoscope has fallen into disrepute as a diagnositic instrument for discerning pathologic changes in body structures.

When a sound is initiated in a large empty room, the persistence of that sound is most striking, this phenomenon being that of reverberation, and being caused by multiple echo reflections repeated in rapid succession within a closed space in which there is little absorption of sound energy. In the conventional diaphragm-type chest piece, just such a closed space exists, in which sound waves initiated by diaphragmatic excursion travel to the walls and other surfaces, and are reflected back and forth at random from multiple surfaces. Because the surfaces are polished and hard, and are nonporous, absorption is poor and sound energy tends to build up as reverberation. Reverberation also tends to be more extensive in smaller chambers because reflections follow one another more rapidly. Reverberation-time in the ordinary chest piece tends to be high, and as a result there is confusion between tones being perceived and the echo-reflections of the preceding tones. Moreover, muddling, indistinctness and lack of intelligibility of the sounds are only too apparent.

It is therefore an object of this invention to provide an improved stethoscope chest piece which is capable of intensifying sound.

It is another object of this invention to provide such a chest piece which will increase the distinctiveness of a plurality of different sounds.

It is another object of this invention to provide such a chest piece which will provide increased resolution of transmitted sounds.

It is another object of this invention to provide such a chest piece which is capable of transmitting sound having an extremely broad range of frequencies.

Other objects and advantages of this invention will readily become apparent from the following description and drawing wherein:

FIG. 1 is a central vertical sectional view taken through one embodiment of the improved stethoscope chest piece of this invention;

FIG. 2 is an enlarged detail view as indicated by the circle II of FIG. 1;

FIG. 3 is another enlarged detail view as indicated by the circle III of FIG. 1; and

FIG. 4 is a view similar to to FIG. 1 showing another embodiment of the stethoscope chest piece of this invention.

Referring now to FIG. 1, there is shown a central vertical sectional view of the improved stethoscope chest piece of this invention, the complete chest piece having the conventional circular configuration. The chest piece comprises a solid body portion **11**, a solid discoid diaphragm **12** and a threaded annular diaphragm ring **13**. The body portion **11** has formed thereon a series of threads **14** complementary to the threaded portion of ring **13**. Additionally, body portion **11** has formed centrally thereof an exteriorly extending boss **15**, which has a central bore **16** formed therein, said bore having a cylindrical configuration and extending completely through the solid body member **11**. An angled extension member **17**, constructed of rigid tubular material and having an outer dimension substantially that of the diameter of bore **16** is permanently affixed within bore **16**. In a conventional manner a sound tube **18** is shown disposed over the distal end of extension member **17** and leads to the remaining portions of a conventional stethoscope, not shown. The sound collecting surface or sound chambers of the chest piece is formed on the side thereof facing diaphragm **12**, and consists primarily of a subchamber A, having a substantially paraboloidal shape, a plurality of concentric grooves **19**, **20**, and a plurality of concentric flats **21**, **22**, **23**, these flats forming interconnecting surfaces between the subchamber A, grooves **19** and **20**, and the surface of the sound chamber portion of body portion **11** which contacts the diaphragm **12**. Preferably, flats **21**, **22** and **23** are formed at an identically small acute angle with respect to diaphragm **12**, an angle which is highly prefered being that of substantially 13 degrees.

Referring now to FIG. 2, the perimeter of body portion **11** adjacent the sound chamber thereof is shown as consisting of an arcuate lip **24**, a narrow horizontal portion **25** and the adjoining angular flat **23**. Upon comparison of FIGS. 1 and 2, it is readily seen that the relieved construction of the perimeter of the body portion **11**, limits the area of body portion **11** required to support the sound producing diaphragm **12** in sound producing relationship therewith, thereby allowing the greatest amount of free movement of the diaphragm.

Referring now to FIG. 3, it is seen that the parabolic section subchamber A is recessed at the outer edge thereof from the plane of horizontal flat **21**, thereby forming a notch **26**.

FIG. 4 represents a modification of the novel chest piece of this invention wherein only one concentric groove is utilized in combination with the parabolic section subchamber A, the remaining elements of the device of this embodiment being substantially the same as the embodiment of FIG. 1.

In practice, the diaphragm **12** may conventionally be formed from any hard, thin material suitable for acoustic

use such as, for example, the material known as Muscovite Mica.

In clinical use, the herein described and claimed stethoscope chest piece has proven to transmit sounds over a greatly increased frequency range; has provided significant intensification of sounds; has adequately transmitted overtones; provides excellent resolution of body sounds; reduces sound reverberation interference and spherical aberration; improves transmission of low pitch, high pitch and second heart sounds, permits easy hearing of emphysematous chest and thick-walled chest sounds; provides naturalness and intelligibility, and is of aid to a diagnostician whose hearing is defective. Clinical experience has shown that the sensitivity of the chest piece of this invention is increased over conventional stethoscopes with heart sounds, including gallops being well appreciated. Low pitch murmurs of mitral stenosis are heard well. Moreover, diagnosis of breath sounds is significantly aided when use is made of the improved stethoscope chest piece of this invention.

While the preferred embodiment of this invention has been described in some detail, it will be obvious to one skilled in the art that various modifications may be made without departing from the invention as hereinafter claimed.

Having thus described my invention, I claim:

1. In a stethoscope chest piece having a sound chamber formed therein, the combination of a thin diaphragm covering said sound chamber, means for retaining said diaphragm in sound transmitting relationship to said sound chamber, a substantially paraboloidal shaped subchamber formed within said sound chamber in sound transmitting relationship with the outlet of said chest piece, an annular groove formed in said chest piece within said sound chamber and concentrically spaced from said subchamber, and an annular flat surface formed on said chest piece interconnecting said groove and said subchamber, said flat surface forming a small acute angle with the plane of said diaphragm.

2. The stethoscope chest piece in accordance with claim 1 wherein said subchamber is recessed with respect to said flat surface.

3. In a stethoscope chest piece having a sound chamber formed therein, a thin diaphragm covering said sound chamber, and means for retaining said diaphragm in sound transmitting relationship to said sound chamber, the improvement which comprises the combination of a substantially paraboloidal shaped subchamber within said sound chamber, the vertex of said subchamber being in sound transmitting relationship with the outlet of said chest piece, the surfaces of said sound chamber without said subchamber including a plurality of grooves spaced concentrically from said subchamber, a plurality of flat annular surfaces interconnecting said grooves, subchamber and diaphragm contacting surfaces of said sound chamber, said flat annular surfaces each forming a common small acute angle with the plane of said diaphragm.

4. The chest piece in accordance with claim 3 wherein said subchamber is recessed with respect to the flat surface connecting said subchamber and the adjacent concentric groove.

5. The chest piece in accordance with claim 3 wherein said comon acute angle is not greater than about 20 degrees.

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