United States Patent

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[54] DIAPHRAGM MOUNTING FOR STETHOSCOPE CHEST PIECE

4 Claims, 5 Drawing Figs.

[52] U.S. Cl. 181/24
[51] Int. Cl. A61b 7/02
[50] Field of Search 181/24

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ABSTRACT: A stethoscope chest piece comprising a microphone housing having surfaces defining an opening into the interior thereof disposed within a circular sidewall and a diaphragm adapted to fit over the opening. The diaphragm consists of a membrane disposed within an elastic ring substantially transverse to the principal plane of the membrane and having inwardly projecting surfaces to engage portions of the sidewall. The diaphragm is thus adapted to be stretched over the bottom of the edge of the sidewall so that the inwardly projecting surfaces may engage with portions of the sidewall. The bottom edge of the sidewall thereafter cooperates in retaining the diaphragm in position.

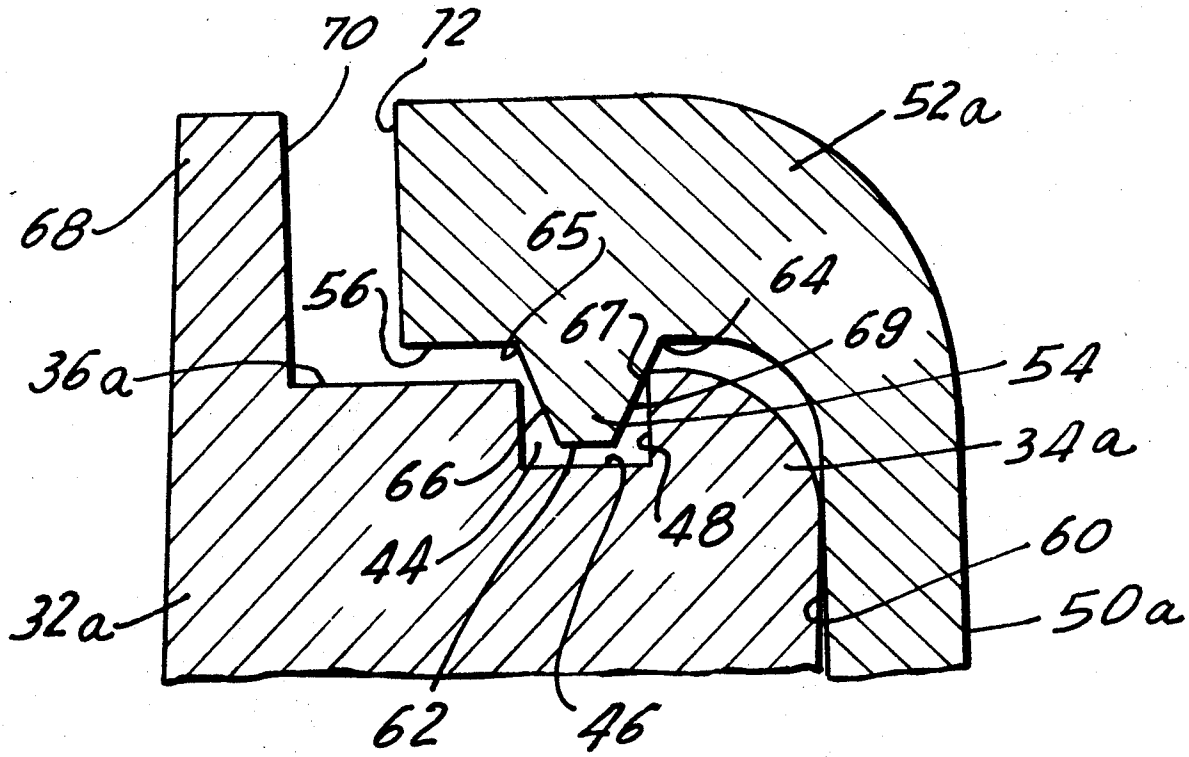


FIG. 1

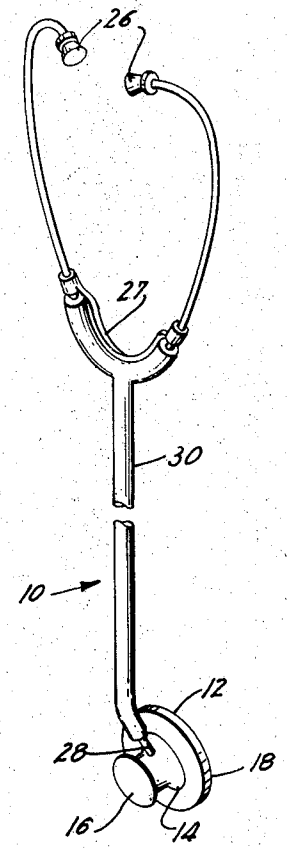


FIG. 4

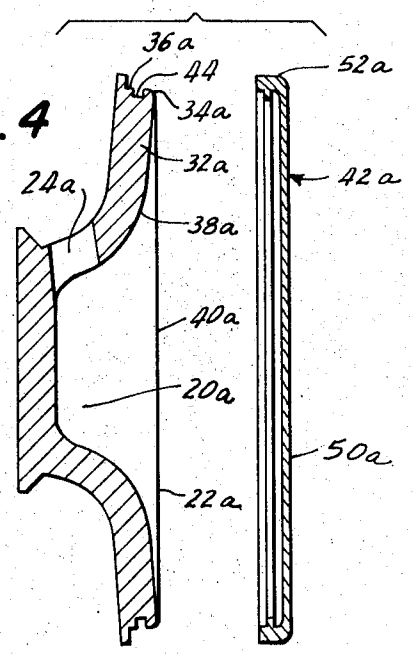
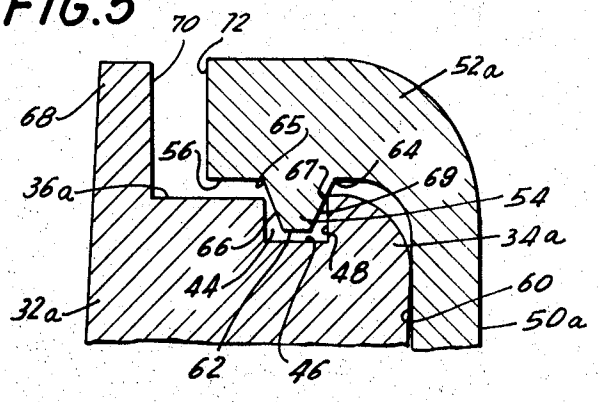


FIG. 5



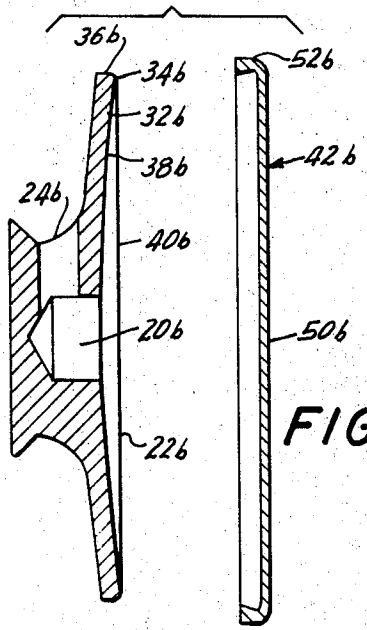


FIG. 2

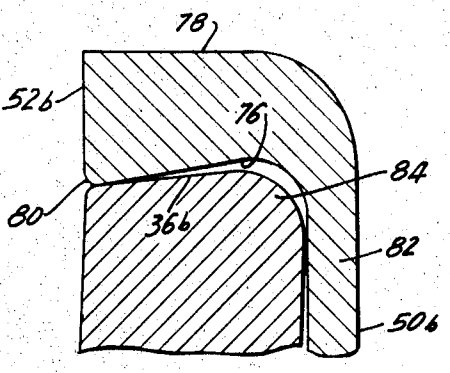


FIG. 3

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DIAPHRAGM MOUNTING FOR STETHOSCOPE CHEST PIECE

CROSS REFERENCE TO RELATED APPLICATIONS

The present application comprises a divisional application of patent application Ser. No. 691,622 filed Dec. 18, 1967 which issued as U.S. Pat. No. 3,470,975 on Oct. 7, 1969.

BACKGROUND OF THE INVENTION

Heretofore stethoscopes having chest pieces in the category usually referred to as the diaphragm microphone type were constructed in three parts; namely, a chest piece housing which contained a bore serving as the microphone core, a diaphragm in the form of a flexible membrane which stretched over the core, and a retaining ring which served to secure the diaphragm to the housing. The most common retaining ring was in the form of an annular collar having a thread disposed about is internal surfaces adapted to engage a similar thread disposed about the periphery of the housing. Portions of the diaphragm were interposed between the ring and housing and thereby retained in position. This arrangement permits the interchanging of diaphragms but has several undesirable features, most obvious of which resides in the separate retaining ring which is relatively costly and requires separate autoclaving and sterilization. Further, considerable effort must be expended in securing the ring to the housing and seeing to it that the diaphragm is properly positioned, and, since the ring is a somewhat delicate part it is often deformed and rendered inoperable by careless handling.

It is therefore the principal object of the present invention to provide a stethoscope chest piece of the diaphragm microphone type which obviates the need for a retaining ring to secure the diaphragm to the housing.

This and other objects and advantages are attained by providing a chest piece housing with a peripheral sidewall apron having a top portion the diameter of which is somewhat less than that of the bottom portion. The diaphragm used in conjunction with the proposed housing includes a membrane disposed within an elastic ring substantially transverse to the principal plane of the membrane and having inwardly projecting surfaces thereon adapted to engage by interference the top portion of the sidewall apron. The elastic ring may thus be expanded over the enlarged bottom portion of the sidewall and thereafter allowed to relax so as to engage the reduced portions. The sidewall bottom thereafter cooperates in retaining the diaphragm in position. By providing an enlarged portion, the diameter of which is slightly larger than that of the ring measured to the inwardly projecting surfaces, the diaphragm may be adapted to "snap" into position when a downward force is exerted on the top of the housing urging it toward the diaphragm membrane.

In the previous and following description "bottom" and "lower" refer to those portions nearer to the patient being auscultated, and "upper" and "top," "topmost," etc. refer to portions away from the patient and nearer the thumb rest portion.

In a somewhat preferred embodiment of the present invention both the housing sidewall and diaphragm ring have tapering cross-sectional configurations, the taper of the ring being slightly steeper than that of the sidewall so as to allow the desired "snap fitting" engagement. In an alternative embodiment the reduced portion of the housing sidewall is in the form of a circumferential groove extending about the entire sidewall and the inwardly projecting portion of the ring comprises a bead disposed about the inner surface of the diaphragm-retaining ring and adapted to fit into the groove when the membrane covers the opening.

DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 is a perspective view of a stethoscope provided with a diaphragm microphone chest piece in accordance with the present invention;

FIG. 2 is an exploded side elevational sectional view of the preferred embodiment of the stethoscope chest piece;

FIG. 3 is a fragmentary side elevational sectional view of the chest piece of FIG. 2 depicting the diaphragm positioned about the housing;

FIG. 4 is an exploded side elevational sectional view similar to FIG. 2 for an alternate embodiment of the stethoscope chest piece of the present invention; and

FIG. 5 is a fragmentary side elevational sectional view of the alternate embodiment of FIG. 4 similar to FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference is now made to the drawings and to FIG. 1 in particular wherein a stethoscope **10** provided with a diaphragm microphone chest piece **12** is depicted. The chest piece **12** includes a housing **14** provided at one end with a thumb rest **16** and a microphone **18** at the opposite end. It will readily be appreciated by one skilled in the art that in place of the thumb rest **16**, a second microphone usually of the bell-type, may be located opposite the microphone **18**. The microphone **18** includes microphone core **20** which is generally in the form of a cylindrically shaped cavity open at one end **22** and in communication with a passageway **24** connecting the core **20** to the earpieces **26**. The housing may be made from any suitable material but has traditionally been constructed from an inert metal such as brass although more recently stainless steel or aluminum have been gaining increased favor. The passageway **24** continues through the stem **28** into the connecting tube **30** which branches to feed the earpieces **26**. A spring **27** extends across the branches tending to keep them close together when the stethoscope is not in use and to urge the earpieces inwardly to maintain a good acoustic seal in the ear while in use.

Referring now to FIGS. 2 and 4 wherein similar parts bear similar numerals but are distinguishable by the suffixes "*a*" or "*b*,"it is seen that the end **22** of the housing **14** opposite the thumb rest **16** terminates in apron **32** extending for some distance outward from the housing. From the bottom **34** of the apron sidewall **36**, the bottom **38** of the apron **32** (that is the end of the housing farthest the thumb rest) flares inwardly terminating in the microphone core **20** while surfaces on the bottom define the opening **40** into the core **20** through which sound waves are transmitted. As was noted, the chest piece is designed to be used with a diaphragm extending across the microphone core opening **40** and in this regard the sidewall **36** is designed to receive and retain the diaphragm **42** in position.

Referring now to FIGS. **4** and **5** in which a first embodiment of the present invention is depicted, it is noted that the sidewall **36***a* is provided with a circumferential groove **44** extending thereabout. The base **46** of the groove is recessed somewhat from the main body of the sidewall **36***a* and parallel thereto. The walls **48** are substantially perpendicular to the base. The diaphragm **42***a* used in conjunction with this chest piece comprises a flexible membrane **50***a* disposed within an elastic ring **52***a* and integral therewith. The ring **52***a* extends substantially perpendicular to the plane of the diaphragm membrane **50***a* and its length is somewhat less than that of the apron **32***a*. A bead **54** is provided about the inner surface **56** of the ring **52***a* and projects inwardly for a distance substantially equal to the depth of the groove **44**. The bead **54** is located from the inside **60** of the membrane a distance equal to the distance from the bottom of the sidewall **34***a* to the groove **44**, so that when the membrane is placed over the housing bottom the groove may receive the bead. In the depicted chest piece the sides **66** and **69** of the bead taper inwardly so as to produce a generally trapezoidal cross-sectional configuration. The base of the trapezoid (measured from **64** to **65**) is greater than the width of the groove thereby insuring some engagement between the side **69** and the outermost edge **67** of the wall **48**.

The groove **44** is adapted to receive and retain the bead **54** in a secure engagement after the bead **54** passes over the bottom portion **34***a* of the apron sidewall. The diaphragm ring **52***a* may be eased over the apron bottom by exerting a slight force thereon so as to force the bead **54** to pass over the bottom portion and enable it to reach the groove where it may

return to its normal shape. Rounding the bottom of the sidewall **34***a* in the manner depicted and seen most clearly in FIG. **5** facilitates the deforming of the ring to enable it to pass over the apron bottom and enables it to be snapped into position. Once the bead **54** passes the housing bottom and comes to rest in the groove **44**, the ring **52** relaxes and reassumes its natural shape and the side **69** of the bead engages the outer edge of the wall **48** of the groove and cooperates with the membrane surface, thereby securing the diaphragm to the housing.

An outwardly extending flange **68** is provided at the upper surface of the apron both for aesthetic appeal and to facilitate the removal of the diaphragm from the housing by providing a fulcrum on which a coin or similarly shaped object may be placed to pry off the diaphragm. Thus the coin may be inserted between the bottom of the flange **70** and the top of the ring **72** and pivoted about the edge of the flange thereby acting as a lever to pry the diaphragm from the housing.

A second, somewhat preferred embodiment of the present invention is depicted in FIGS. **2** and **3**. In this embodiment, the sidewall **36***b* of the apron and the inner surface **76** of the ring both taper so that the diameter of each measured at the bottom is greater than that at the top. That is, for the nontapering ring outer wall **78** depicted in FIG. **3**, the ring thickness measured at the top is greater than at the bottom. However, the taper of the ring **76** is somewhat steeper than that of the apron. Also, the diameter of the ring measured at the top **80** (i.e. the end farthest the membrane **50***b*) is less than the diameter of the apron measured at any point thereon so as to insure an interfering engagement between the ring and the sidewall **36***b* when the diaphragm is placed about the apron. As in the previously described embodiment the bottom contour **84** of the apron sidewall is rounded and serves as a camming surface to initially guide the elastic ring over the sidewall. Thus, the ring is stretched over the apron bottom and thereafter allowed to relax until the inwardly projecting upper portion **80** or some portion of the inner surface contacts the sidewall and engages it by interference therewith. The bottom portion of the apron, that is those portions below the point of contact with the ring, have a diameter larger than the top of the ring and thereby cooperate in retaining the ring to the apron and hence the diaphragm in position.

As was stated, in both embodiments it is necessary that the diaphragm ring be sufficiently elastic to enable it to pass over the enlarged portions of the housing apron and thereafter resume its normal shape unless prevented from doing so by interference from a portion of the housing. In this regard, successful results have been obtained by manufacturing diaphragms of acetal, polypropylene and materials of a similar nature.

It can thus be appreciated that in accordance with the teachings of my invention, a stethoscope chest piece of the diaphragm microphone type may be produced which obviates the need for a separate retaining ring in order to secure adequate coupling between the diaphragm and housing. It should be understood that modifications may be made in the illustrated and described embodiments of my invention without departing from the invention as set forth in the accompanying claims.

I claim:

1. A diaphragm microphone stethoscope chest piece comprising in combination a chest piece housing and a diaphragm adapted to be secured to one end of said housing wherein said housing is defined within a circular apron, said apron having an inwardly extending groove disposed thereabout spaced rearward of the diaphragm contacting front end, said diaphragm comprising an elastic ring and a flexible membrane formed integral with the ring and extending across the ring, said ring having an inwardly directed bead disposed about the interior surface thereof and spaced apart from the membrane a distance substantially equal to the distance between said housing groove and said housing diaphragm contacting end, said diaphragm bead being tapered inwardly and away from said diaphragm membrane from a point spaced apart from said membrane a distance less than the distance between said housing diaphragm contacting end and said housing groove, the diameter of said ring measured at said bead being less than the housing apron diameter so that when the diaphragm is placed in operative contact with said housing, the elastic ring may be stretched over the diaphragm contacting end of the housing to engage the groove of the housing apron in a stretch fit whereafter motion of the diaphragm membrane relative to the housing is prevented by said bead contacting the surfaces defining said groove.

2. The invention in accordance with claim **1** wherein the diaphragm receiving end of said housing apron is rounded to provide a camming surface adapted to stretch said diaphragm elastic ring so as to allow said ring bead to pass over the diaphragm-receiving end of said housing.

3. The invention in accordance with claim **1** wherein a hollow-branched connecting tube is coupled to said chest piece, the bore of said tube being in communication with an opening in said housing extending from said diaphragm contacting end of said housing and the branches of said tube having air pieces thereon.

4. A diaphragm for use with a stethoscope chest piece housing of the type having a groove extending inwardly from a circular apron defining the housing periphery, said groove being spaced apart a distance from one end of the housing, said end being adapted to contact, receive and secure said diaphragm; said diaphragm comprising: an elastic ring and a flexible membrane disposed within and extending from surfaces integral with said elastic ring, said ring having an inwardly directed bead disposed about the interior surface thereof and spaced apart from the membrane a distance substantially equal to the distance between said housing groove and said housing diaphragm contacting end, said diaphragm bead being tapered inwardly and away from said diaphragm membrane from a point spaced apart from said membrane a distance less than the diameter between said housing diaphragm contacting end and said housing groove, the diameter of said ring measured at said bead being less than the diameter of said apron so that when the diaphragm is placed in operative contact with said housing, the elastic ring may be stretched over the diaphragm-contacting end of the housing to engage the housing groove in a stretch fit whereafter motion of the diaphragm membrane relative to the housing is prevented by said bead contacting the surfaces of said housing defining said groove.