ABSTRACT OF THE DISCLOSURE

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 diameter of the sidewall is nonuniform and in this regard has an increased diameter on the diaphragm contacting side and a decreased diameter away from the diaphragm contacting side. The diaphragm ring is thus adapted to be stretched over the bottom edge of the sidewall so that the inwardly projecting surfaces of the elastic ring may engage the portions of the sidewall of decreased diameter. The portions of the sidewall of increased diameter thereafter cooperate in retaining the diaphragm in position.

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 its 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 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 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 dia-

phragm 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 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 ear piece 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 ear pieces 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 ear pieces 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 apron 32 as 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 36a 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 36a and parallel thereto. The walls 48 are substantially perpendicular to the base. The diaphragm 42a used in conjunction with this chest piece comprises a flexible membrane 50a disposed within an elastic ring 52a and integral therewith. The ring 52a extends substantially perpendicular to the plane of the diaphragm membrane and is stretched between the bottom of the apron 32a. A bead 54 is provided about the inner surface 56 of the ring 52a and projects inward 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 wall 34a 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 depth 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 34a of the apron sidewall. The diaphragm ring 52a 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 34a in the manner depicted and seen most clearly in FIG. 5 facilitates the deformability 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 reasserts 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 36b 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 non-tapering 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 32. Also, the diameter of the ring measured at the top 80 (i.e. the end farthest the membrane 50c) is less than the diameter of the apron measured at any point thereof so as to insure an interfering engagement between the ring and the sidewall 36b 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 to guide the diaphragm ring 52b into the housing. 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 assume 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 substituted for the illustrated and described embodiments of my invention without departing from the invention as set forth in the accompanying claims.

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 of nonuniform diameter, said apron having an increased diameter proximal the diaphragm contacting end and a decreased diameter away from said diaphragm contacting end, and said diaphragm comprises an elastic ring and a flexible membrane formed integral with said ring and extending across the ring, said ring having a smaller inside diameter than the increased diameter of said apron, the inside diameter of said ring tapering inwardly from the interface between said ring and said membrane so that when said diaphragm is placed in place said housing, the elastic ring of the diaphragm may be stretched over the diaphragm contacting end of the housing to engage the housing apron in a stretch fit whereby motion of the diaphragm membrane relative to the housing is prevented by said apron increased diameter.

2. 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 the housing opening and the branches of said tube having ear pieces thereof.

3. The invention in accordance with claim 1 wherein the diaphragm receiving end of said apron is rounded so as to provide a camming surface adapted to stretch said diaphragm elastic ring and allow said elastic ring to pass over the increased diameter of said diaphragm receiving end of said apron.

4. A diaphragm for use with a stethoscope chest piece housing of the type having surfaces disposed within a circular apron of nonuniform diameter defining an opening into the interior thereof, said apron having one end adapted to receive and secure a diaphragm, said apron having an increased diameter proximal the diaphragm contacting end and a decreased diameter away from said diaphragm contacting end; said diaphragm comprising: an elastic ring and a flexible membrane disposed within and extending from surfaces integral with said elastic ring, said ring having a nonuniform inside diameter tapering inwardly from the surfaces integral with said membrane, the inside diameter of said ring being smaller than the increased diameter of said apron so that when the diaphragm is
placed in operative contact with the housing apron, the
elastic ring of the diaphragm will engage the apron and
cause the diaphragm to form a stretch fit over the apron
whereafter motion of the membrane relative to the hous-
ing is prevented by said apron increased diameter.

References Cited

UNITED STATES PATENTS
872,448 12/1907 Penhallow 181—24
1,157,428 10/1915 Sheppard 181—24 10

FOREIGN PATENTS
1,550,287 8/1925 Sovatkin 181—2c
2,258,743 10/1941 Dax 181—2c
1,208,208 9/1959 France.

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