United States Patent

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[72] Inventors **Donald W. Orlowski**
Glenview;
Donald S. Schroeder, Barrington, Ill.

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[73] Assignee **Ampex Corporation**
Redwood City, Calif.

[54] **GROMMET FOR SPEAKER ENCLOSURE**
4 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **174/153,** 16/2, 181/31, 248/56, 277/178
[51] **Int. Cl.** **H01b 17/30,** H04r 7/16, F16l 5/02
[50] **Field of Search** ..... 174/65 (G), 152.2, 153 (G); 339/103 (B), 106; 277/178; 248/56; 16/2; 179/1 (E), 178—179; 181/31.1

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Primary Examiner—Laramie E. Askin
Attorneys—Anderson, Luedeka, Fitch, Even and Tabin and Robert G. Clay

ABSTRACT: A resilient grommet for forming an airtight seal in an opening while permitting the airtight passage of an electrical cord through the opening. The grommet provides strain relief for the cord and is provided with a series of ribs to prevent pullout.

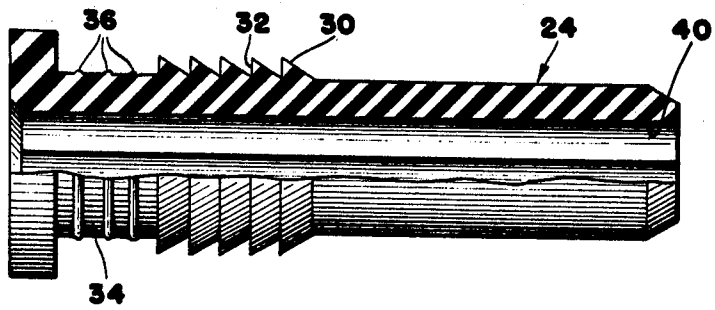


FIG.1

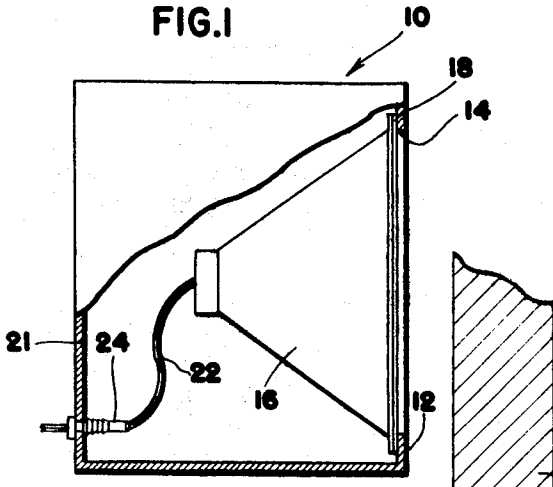


FIG.4

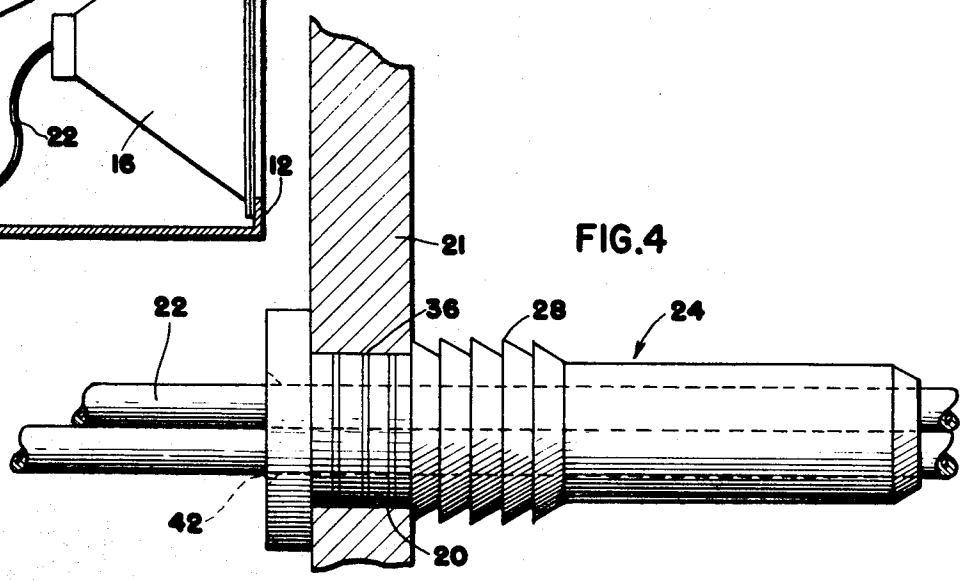


FIG.2

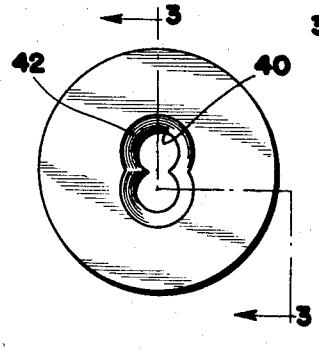


FIG.5

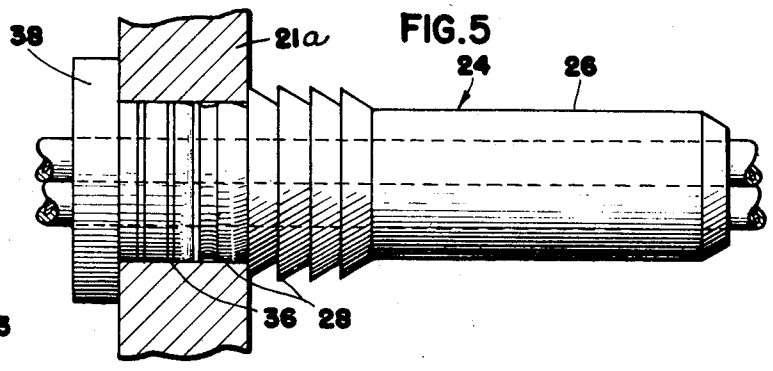
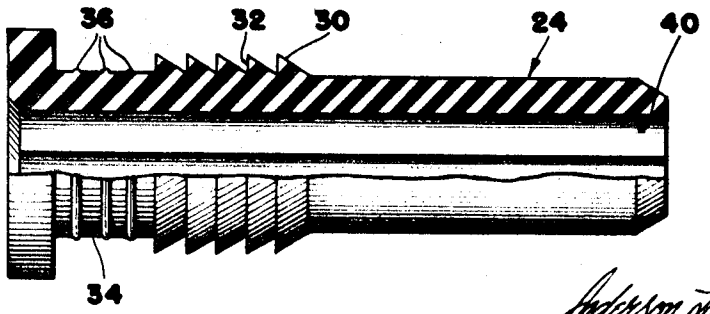


FIG.3



INVENTORS
DONALD W. ORLOWSKI
DONALD S. SCHROEDER

Anderson, Luedeka, Fitch, Even & Tabin
ATTYS.

GROMMET FOR SPEAKER ENCLOSURE

The present invention is directed to a grommet suitable for permitting of a cord or the like through an opening in a wall. The invention finds particular application in the field of high quality sound reproduction where it is necessary to provide access to a speaker enclosure for an electrical cord, carrying operating power for the speaker, while providing strain relief for the cord and a complete air seal of the opening through which the cord passes into the speaker enclosure.

In the field of sound reproduction, one principle of speaker design has been developed called air suspension. It involves a completely sealed enclosure for mounting the speaker driver or unit. The enclosure contains only static trapped air and permits essentially no airflow into or out of the enclosure in the area behind the speaker. The trapped air serves as a linear pneumatic spring which restores the cone to its equilibrium position after it has been deflected inwardly or outwardly in response to an audio signal. In order for such an air suspension speaker to be operative there should be provided an essentially complete air seal of the enclosure behind the speaker so that a pressure differential is established between the air in the enclosure and the ambient air whenever the speaker cone moves from its equilibrium position. This differential operates to restore the speaker cone to its equilibrium position after each audio signal is received.

While most of the design of such an enclosure is not difficult in order to affect a seal, the one obvious area for air leakage in the enclosure is the opening for the passage of the speaker cord or wire to the terminals of the speaker. In order to be effective, the sealing means around the cord extending through the wall of the speaker enclosure should provide a completely airtight seal between the opening in the housing and the cord as well as providing strain relief to avoid shorting or breaking of the cord by bending.

It is an object of the present invention to provide an grommet suitable for forming a complete air seal between an opening in a wall and a cord passing through the opening.

It is a further object of the invention to provide a sealing means adaptable for use with openings in walls of different thickness.

It is another object of the present invention to provide a combined air seal and strain relief for passing a cord through an enclosure wall.

These and other objects of the present invention will become obvious in connection with the following description and drawings in which:

FIG. 1 is a side elevational view of a speaker enclosure partially in cross section and embodying the present invention;

FIG. 2 is an end view of one embodiment of a grommet of the present invention;

FIG. 3 is a side view partially in section of a grommet taken along line 3–3 of FIG. 2;

FIG. 4 is a fragmentary cross-sectional view of the embodiment of FIG. 2 in an enclosure wall; and

FIG. 5 is a fragmentary cross-sectional view of the embodiment of FIG. 2 mounted in a second enclosure wall.

In the embodiment illustrated in FIG. 1 a speaker enclosure 10 of the air suspension variety is shown in side elevation with the nearest sidewall broken away to show the inside of the enclosure. The enclosure may be made of any suitable material such as wood and is in the form of a rectangular box having a front wall 12 which contains an opening 14 in which a speaker 16 is mounted. The speaker 16 may be of any conventional configuration and maybe of oval or circular cross section. In order to form a seal with the front wall a resilient gasket 18 is provided between the rim of the speaker cone and the inside of the front wall 12. Fastening of the speaker to the front wall may be accomplished by any conventional means such as screws which compress the rim of the speaker cone against the resilient gasket 18 to form a seal. Although only one speaker is illustrated it is understood that more than one speaker may be so mounted in the enclosure without departing from the invention. The remainder of the speaker enclosure is joined at right angle corners and sealed by glueing or other sealing means.

The only remaining inlet for air to enter and exit the enclosure is provided by an opening or hole 20 in the back wall 21 of the enclosure.

In the illustrated embodiment the opening 20 is positioned on the lower portion of the backwall as the speaker sits in an upright position, however, it could be located at any point on the backwall or any wall of the enclosure. The purpose of the opening in the wall is to permit an electrical cord 22 to be brought into the speaker enclosure and be connected to the terminals of the speaker 16. As mentioned earlier, in an air suspension type of speaker system it is necessary that there by substantially no access to outside air for the air within the speaker enclosure. The reason for wanting to exclude any movement of air in and out of the speaker unit is that air when confined acts elastically and compressing of the air results in an increase in pressure. The increased pressure tends to cause expansion of the inside of the enclosure until the air reaches ambient pressure at its original volume. Thus, when the speaker cone moves inwardly and lowers the internal volume of the speaker enclosure, the pressure inside the enclosure is raised to a level above the room pressure outside of the enclosure. As the air within the enclosure attempts to equalize itself in pressure with the pressure within the room, it acts as a spring and exerts a force on the entire back surface of the cone of the speaker pushing it back toward the equilibrium position. In like manner, if the speaker is moved by a signal in a direction outward of the enclosure causing the volume of the enclosure to increase beyond its static condition the pressure within the enclosure will become lower than the ambient pressure and a force will be exerted on the other surface of the speaker cone by the room air causing it again to return to an equilibrium position in which the pressure within the enclosure is equal to the ambient pressure outside the enclosure.

There is inherently in the speaker cone itself a small amount of leakage which permits very slow movement of air through the speaker surface. This low rate of leakage does not affect the air suspension properties of the speaker because the movement of the speaker cone in response to signals from the audio input is of such short duration that the leakage has no opportunity to occur and has no effect on the dynamic properties of the speaker. At the same time this low rate of leakage does permit the pressure within the enclosure to equalize with the ambient pressure in response to the gradual changes in atmospheric pressure so that in static condition the pressure within the enclosure is always equal to the pressure on the outside of the enclosure within the room. Thus, changes in atmospheric pressure do not change the equilibrium point of the speaker cone.

In order to assure that a slow rate leakage through the apex of the speaker cone is the only means for air movement into and out of the enclosure, the opening 20 in the rear wall 21 is provided with a grommet 24 which is inserted in the opening 20 and surrounds the cord 22 forming a complete air seal in the opening 20.

Referring now to FIGS. 2 and 3 one embodiment of a grommet of the present invention is illustrated. The grommet may be made of any suitable resilient material such as chlorobutadiene polymer or other types of synthetic rubbers. As illustrated the grommet 24 is made up of an elongate cylindrical body of resilient material and is of circular cross section at all points along its length regardless of changes in diameter. It could, of course, be made oval or some other shape without departing from the scope of the invention in the event that the opening 20 in the housing should for some reason be desired to be other than circular.

Referring again to FIG. 3 showing the grommet partially in cross section taken along line 3–3 of FIG. 2, the body of the grommet is divided into several different areas. The first of these areas is an elongate stem 26 of constant circular diameter. The stem 26 is of sufficient length to extend completely through the wall of the speaker enclosure in which the grommet is to be inserted so as to provide a means for grasping the grommet to pull it into position during assembly. Since the

grommet is adaptable to several wall thicknesses the stem **26** should be longer than the thicknesses of the thickest wall in which the grommet is to be inserted. The stem **26** is also of a diameter just slightly smaller than the opening in the wall of the housing into which it is to be inserted so that it may be freely inserted without any friction.

A series of ribs **28** extending circumferentially around the grommet are provided at one end of the stem **26** and define a larger diameter portion of the grommet. Each rib **28** is provided with a sloping face **30** and a perpendicular face **32**. The first sloping face **30** begins at the terminal point of the stem **26** and is of equal diameter with the stem at that point. It extends outwardly to a larger diameter in a direction sloping away from the stem **26**. The perpendicular face **32** which is perpendicular to the common central axis of the entire grommet extends outwardly from the surface of the main body of the grommet until it intersects the sloping face **30** to form a sharp rib **28**. The adjacent rib then begins with another sloping face which intersects the smallest diameter of the previous perpendicular face **32** at approximately the same diameter as the diameter of the stem **26**. In the illustrated embodiment five ribs are shown in succession each having the same outer diameter formed by the intersection of the perpendicular face **32** and the sloping face **30** and each having the sloping face **30** extending in the same direction outward and away from the stem **26**. The actual number of ribs employed is a matter of choice; however, employing five ribs as illustrated provides a sufficient number of ribs to adapt the grommet to several wall thicknesses as will be explained hereinafter.

After the last rib **28**, the grommet is provided with an area of constant diameter **34** larger than the diameter of the stem **26** and approximately equal to the diameter of the opening **20**. The area of constant diameter **34** is interrupted in the illustrated embodiment by three raised portions **36** of generally semicircular cross section extending peripherally around the grommet at equally spaced intervals along the constant diameter portion **34**. The outer diameter of the raised portions **36** is larger than the diameter of the opening **20** in the wall of the speaker enclosure. Therefore, when the grommet is inserted in the opening in the enclosure wall the raised portions **36** are compressed and form an air seal with the opening **20**. At the same time the compression of the raised portions causes the grommet to form a second seal around the cord **22** as will be explained hereinafter. Finally, the grommet is provided with a circular flange **38** which extends radially beyond the remainder of the grommet. The purpose of the flange **38** is to provide an abutting surface on the outer surface of the wall at the opening **20** thereby preventing the grommet from being pulled through the opening **20** when it is inserted. It also functions to assist in the air sealing of the opening **20**. The diameter of the flange **38** is substantially greater than the opening **20** to insure that the grommet will not be pulled through the opening and into the enclosure during assembly or afterward.

As best seen in FIGS. **2** and **3** the grommet is provided with an opening **40** along its central axis which extends with constant cross section from the flange end of the grommet to the opposite end of the stem **26**. This opening provides the passage for the cord to be inserted into the speaker and attached to the terminals. In the illustrated embodiment the opening **40** is formed by two cylinders each having equal radius and having their centers spaced slightly less than a diameter apart. The resulting cross section seen in FIG. **2** is that of a FIG. **8** and is adapted to receive a double lead cord **22** such as shown in FIG. **4**. If other shapes of cord are to be employed the central opening **40** should have the cross section of that cord.

The central opening **40** is dimensioned to be slightly larger than the dimensions of the cord to be received so that the cord may be easily inserted therein. The central opening is also provided, at the end of the grommet having the flange **38**, with a chamfer **42** to assist the insertion of the cord into the opening.

The operation the grommet **24** can best be seen by reference to FIGS. **4** and **5**. The cord **22** is first inserted through the central opening **40**. Since the opening is of slightly larger dimension than the cord there is little friction and the cord can be pushed through the grommet. The grommet and cord are then inserted through the opening **20**. In performing this operation the stem **26** can be easily grasped and pulled into the enclosure causing the remainder of the grommet to be pulled through the opening **20**. The grommet is pulled into the opening **20** until the flange **38** abuts the outer surface of the backwall **21**. During the insertion operation the resilient ribs **28** are compressed in order to pass them through the opening **20**. As each rib passes through the opening and into the enclosure it returns to its original shape and provides a stop by means of the perpendicular face **32** which resists the pull out of the grommet in the opposite direction. In its inserted position as shown in FIG. **4** with the thinnest housing wall for which it is designed all of the ribs **28** are within the enclosure with the perpendicular face **32** of the final rib just abutting the inner surface of the wall **21**. The three raised portions **36** remain within the opening **20** and provide the required sealing action by being compressed against the periphery of the opening **20**. The compression of the raised portions **36** causes the area within the grommet just below each of the raised portions to also be compressed into contact with the outer surface of the cord **22** forming a second seal therewith. Thus, the entire opening is sealed to air movement both at the passage of the cord and at the passage of the grommet through the opening **20**.

FIG. **5** illustrates the grommet inserted into a thicker wall **21***a*. In this application the same grommet is used and is inserted into the wall in the same fashion as described above with reference to FIG. **4**. In this environment, however, the final rib **28** does not enter the enclosure but remains in its flexed position with the opening **20** to assist the three raised portions **36** in forming the air seal between the grommet and the opening **20**. As in the application of FIG. **4** the primary seal in the opening **20** is still provided by the compression of the raised portions **36**. In addition, the compression of the final rib assists in the compression of the opening **40** onto the wire to form the second seal. As in the application of FIG. **4** the first perpendicular face **32** within the enclosure, in this case on the next to last rib, is positioned against the inner surface of the wall **21***a* to prevent pull out of the grommet.

It can therefore readily be seen that the grommet shown is adaptable to several wall thicknesses by having successive ribs remain in compression within the opening while retaining the feature that the perpendicular face **32** of one of the ribs is always adjacent the inner surface of the wall to prevent pull out.

If for a particular application it is felt that prevention of cord pull out from the grommet is necessary beyond that provided by the squeezing action of the grommet on the cord of the opening **20** a knot can be tied in the cord **22** just inside the end of the stem **26** and the cord can be pulled slightly outward so that the knot locks within the resilient opening **40** at the end of the stem **26**. This action does not assist or detract from the sealing effect but merely provides a better anchor for the cord against pull out.

The grommet described above provides the speaker enclosure with several desirable features simultaneously. First, it forms an airtight seal necessary to the operation of an air suspension speaker system while permitting the lead cord to be inserted through the wall of the speaker enclosure. Secondly, it provides good strain relief for the cord as it passes through the opening to avoid shorting caused by sharp bends against the edge of the opening **20**. It is further assisted at the outer end of the grommet by the chamfer **42** which provides a transition area for the cord **22** as it enters the central opening.

In addition to these two advantages in the operation of the speaker unit the grommet also provides features of adaptability and ease of assembly. The adaptability is provided by the series of ribs which permit the grommet to be inserted in walls of varying thicknesses. The ease of assembly is provided by the stem **26** which is designed to be of a smaller diameter than the opening **20** and can be readily inserted and pulled through

from the inside to avoid the bunching and twisting caused by trying to push the grommet into the opening **20**. Accordingly, the present invention has provided a versatile low cost strain reliever which provides an airtight seal for conducting a lead cord through an opening in a speaker enclosure.

We claim:

1. A resilient grommet for forming an airtight seal for wires passing through an opening, said grommet comprising

a first cylindrical portion provided with a plurality of axially spaced circumferential ribs,

a second cylindrical portion coaxial and integral with one end of said first cylindrical portion, said second cylindrical portion being provided with a plurality of axially spaced circumferential rings, said rings extending slightly beyond the outer surface of said second cylindrical portion,

a central opening extending through the entire length of said grommet parallel to the common axis, said central opening being of uniform cross section and adapted to receive an electrical cord extending through said grommet.

2. A grommet defined in claim **1**, further comprising a resilient flange integrally formed at the end of said second cylindrical portion remote from said first cylindrical portion, said flange being of larger diameter than said second cylindrical portion and adapted to provide an abutting surface when said grommet is positioned in an opening to form a seal.

3. A grommet defined in claim **1**, further comprising an elongate stem integrally formed and coaxial with said first cylindrical portion, said stem being of smaller diameter than said first cylindrical portion and extending from the end of said first cylindrical portion remote from said second cylindrical portion.

4. A grommet defined in claim **1**, wherein said circumferential ribs comprise a sloping face and a perpendicular face, said sloping face extending radially outward and toward said second cylindrical portion, said perpendicular face extending radially outward perpendicular to the axis of said cylindrical portion and intersecting said sloping face to define a circular edge.