June 14, 1955 J. J. CANTOR 2,710,427

METHOD OF MAKING EAR STOPPERS

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FIG. 1.

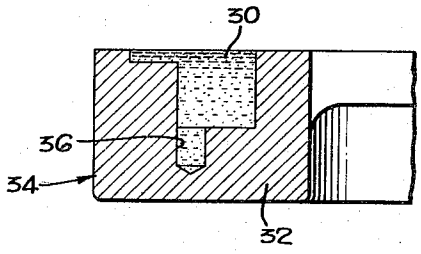


FIG. 2.

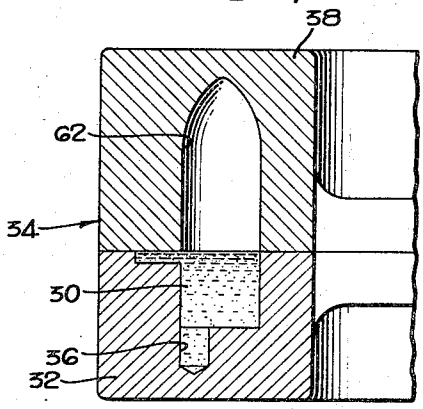
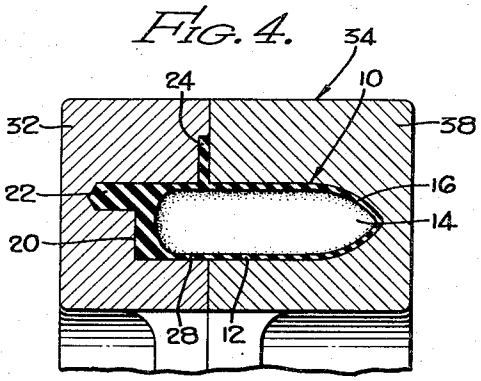


FIG. 4.



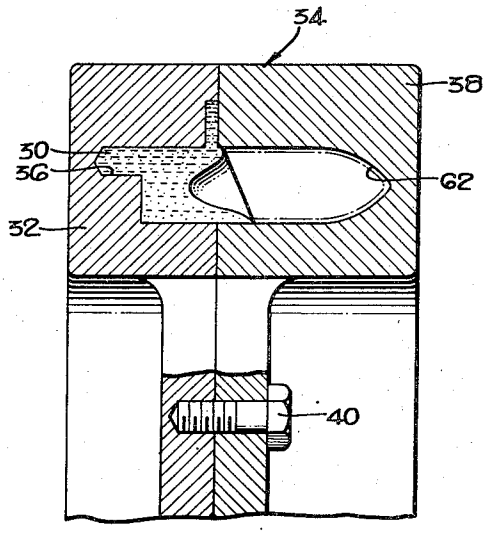


FIG. 3.

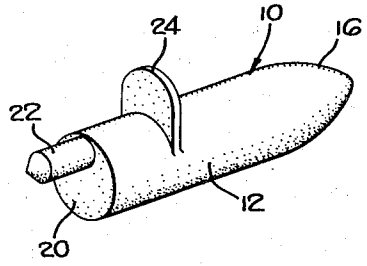


FIG. 5.

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METHOD OF MAKING EAR STOPPERS

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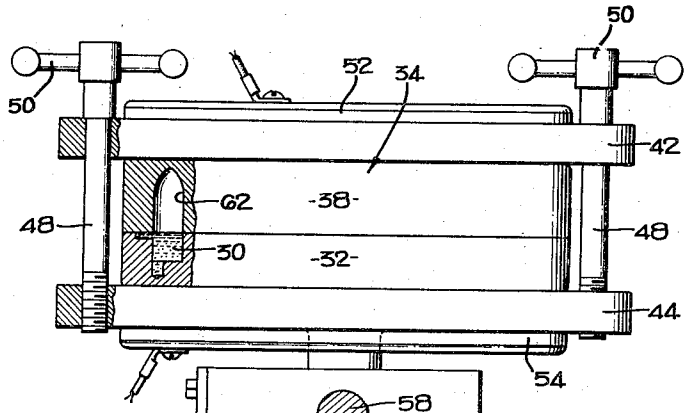


FIG. 6.

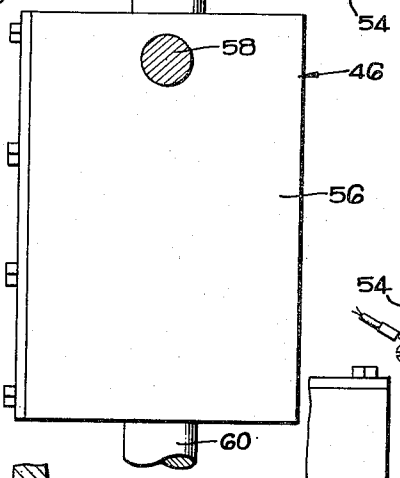
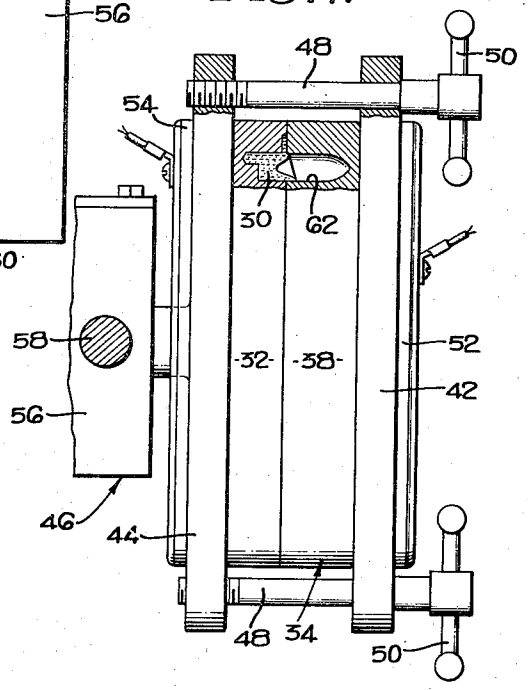


FIG. 7.



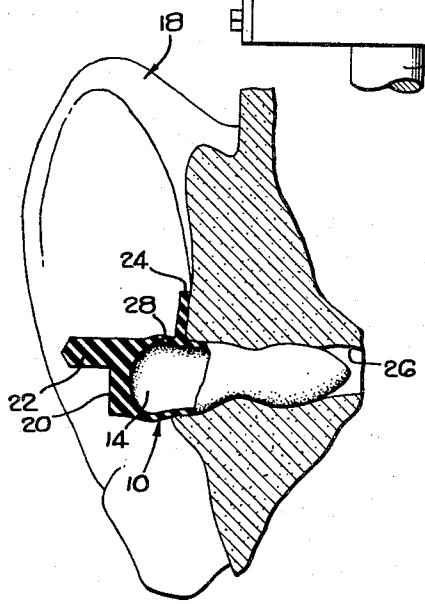


FIG. 8.

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United States Patent Office

2,710,427

Patented June 14, 1955

2,710,427

METHOD OF MAKING EAR STOPPERS

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Application November 19, 1953, Serial No. 393,197

1 Claim. (Cl. 18—58.3)

This invention has to do with structure dampening sound, and more particularly with stoppers that may be inserted in the human ear. It has been determined through scientific and practical research that the ear drum vibrates the minutest amount when sound is imposed thereon and by virtue of this fact sound is conducted to the inner ear. In order to reduce the amount of sound reaching the inner ear it has been determined that it is necessary to stop or retard the vibration of the ear drum. This invention is predicated on the idea that no sound can be produced unless mechanical or intermolecular friction is present.

Therefore, one of the principal objects of this invention is to provide a gas filled ear stopper that will retard the movement of the ear drum, reduce the conduction of sound to the middle and inner ear, and have a minimum amount of friction between the ear stopper and the walls of the external canal.

Another object of this invention is to provide an ear stopper that will fit snugly in the external canal of the human ear in such a manner as to cause the sealing of the external canal and at the same time compress the air in the canal and retard the movement of the ear drum.

Another object of this invention is to provide an ear stopper having relatively thin, seamless walls that is hermetically sealed and gas filled and will conform to the configuration of the external canal of the human ear and cause a greater than atmospheric pressure to be exerted in the external canal between the innermost end of the ear stopper and the ear drum.

Another object of this invention is to provide an ear stopper wherein the confined gases in the hermetically sealed thin-walled envelope will create sufficient pressure on the walls of the envelope to distort said envelope, thereby compressing the trapped air in ear canal and tending to depress the tympanic membrane.

Another object of this invention is to provide an ear stopper, the rear end of which is distorted when the stopper is placed in the external canal that will cause the same to conform to the configuration of the external canal, resulting in a greater than atmospheric pressure being exerted within the human ear.

Another object of this invention is to provide an ear stopper wherein the compressed portions of the thin-walled, gas-filled envelope will tend to expand the uncompressed portions when the ear stopper is inserted into the external ear canal and by virtue of this fact the ear stopper is self-returning.

Another object of this invention is to provide an ear stopper having no mechanical movement between its parts and having structure thereon that will limit the inward movement or insertion of the ear stopper into the external canal, and structure that will enable the ear stopper to be removed from the human ear.

A further object of this invention is to provide an ear stopper wherein the materials composing the ear stopper have a minimum coefficient of friction.

A further object of this invention is to provide an ear stopper which will enfold the cartilaginous protuberances of the external ear canal and force itself down into the rugae which form the walls of the normal ear canal.

Another principal object of this invention is to provide a method of mass molding, coagulating and curing of ingredients that are utilized to form ear stoppers.

A yet further object of this invention is to provide a method of making ear stoppers that have relatively thin walls in order that the stoppers will conform to the configuration of the external canal of a human ear.

A still further object of this invention is to provide a method of making ear stoppers for the human ear that will have a gas entrapped and retained within the ear stopper.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claim, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

Figure 1 of the drawings is a fragmentary sectional view of one section of the mold used for molding ear stoppers and having placed therein ingredients that are utilized for making ear stoppers;

Fig. 2 is a fragmentary sectional view illustrating two sections of the mold placed in juxtaposition;

Fig. 3 is a fragmentary sectional view illustrating the manner of securing the two sections of the mold together and showing in dotted lines the flow of the ingredients from one section of the mold to the other section;

Fig. 4 is a fragmentary sectional view illustrating the configuration of the ear stopper when the ingredients used for making the same have occupied each section of the mold;

Fig. 5 is a perspective view illustrating the ear stopper of this invention;

Fig. 6 is a fragmentary sectional view illustrating the initial position of the press and mold prior to the ingredients occupying each section of the mold, as illustrated in Fig. 3 of the drawings;

Fig. 7 is a view similar to Fig. 6, but illustrating the mold and press rotated 90°, and including the position of the ingredients assumed in the mold, as illustrated in Fig. 3 of the drawings; and

Fig. 8 is a fragmentary sectional view illustrating the ear stopper of Fig. 5 inserted into the external canal of a human ear.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, **10** broadly designates a seamless ear stopper which comprises an elongated, hollow, envelope **12** having a gas filled chamber **14** therewithin which is entirely closed throughout. The ear stopper **10** has a mass which is sufficient to impede, reflect and repel the sounds that normally occur to those persons subjected to excessive noises.

One end **16** of envelope **12** is tapered to facilitate the entrance of the ear stopper into the human ear **18**. The end **20** opposed to end **16** has extending therefrom a projection **22** that enables the wearer of the ear stopper **10** to remove the same from the ear **18**.

Formed on the envelope **12** and between the two ends **16** and **20** is an arcuate tab **24** that acts as a stop to limit the amount of the ear stopper **10** that may be inserted into the external canal **26** of the human ear **18**.

Chamber **14** has hermetically entrapped therein gases that maintain the ear stopper **10** in the inflated condition, as illustrated in Fig. 5 of the drawings.

The end **20**, as may be seen in Fig. 8 of the drawings, has a wall thickness that is greater than that of the envelope **12** and the end **16**. When the ear stopper **10** is

inserted into the external canal **26** of the human ear **18** it assumes the configuration of the external canal **26** and imposes a tight fit therein. By virtue of this tight fit and distortion of the ear stopper **10** the wall **28** between tab **24** and end **20** is expanded outwardly. In other words, the gases entrapped in chamber **14** are compressed in such a manner as to cause an expansion of wall **28**. This expansion results in maintaining a tight fit in the external canal **26** of the human ear and also results in a greater than atmospheric pressure being exerted in the external canal between the end **16** of the ear stopper **10** and the ear drum of the human ear.

This greater than atmospheric pressure results in retarding the movement of the ear drum, and by virtue of this fact sound is dampened and the conduction of sound to the middle and inner ear is greatly reduced.

Further, it has been determined that ear stoppers prior to the present invention have placed solids in various forms in chambers similar to that of chamber **14**. Instead of the solids dampening, reflecting or retarding sound, they have, on the contrary, conducted the same to the middle and inner ear. In other words, sound striking one of the particles of solids which is in contact with another particle will be conducted by virtue of a chain conduction to the middle and inner ear. Each of the solid particles will be caused to vibrate by sound striking the same and this vibration will be conducted to the next particle, and so on, into the middle and inner ear.

The method of making an ear stopper **10** comprises mixing the liquid polyvinyl chloride plastisol with graphite. In order to obtain a thorough mixture of the two, the polyvinyl chloride plastisol is added to the graphite in a mixing chamber. The thoroughly mixed polyvinyl chloride plastisol and graphite **30** is then poured into one section **32** of a mold, broadly designated by **34**, in the manner as illustrated in Fig. 1 of the drawings. This section of the mold includes that part which forms that portion of the ear stopper **10** between tab **24** and projection **22**. Due to the viscosity of the ingredients **30** they do not readily occupy that portion of the mold that has to do with forming the projection **22**. Therefore, section **32** is inserted into a vacuum chamber which causes the air occupying cavity **36** of the section **32** to be drawn through the ingredients **30** and, as a result, the polyvinyl chloride plastisol and graphite is enabled to fill and occupy the cavity **36**.

Section **38** of the mold **34** is then placed upon section **32** in juxtaposition, as illustrated in Fig. 2 of the drawings. The two sections of the mold are rigidly secured together by bolts **40**, or equally applicable structure. It is important to note that the two sections **32** and **38** of the mold **34** must be tightly secured together. If this is not maintained, gases that are to occupy chamber **14** of ear stopper **10** will be permitted to escape from the mold, causing an imperfection to be formed in ear stopper **10**. The secured sections of the mold **34** with the ingredients **30** therein are then placed between plates **42** and **44** of a press, broadly designated by **46**, as illustrated in Figs. 6 and 7 of the drawings.

Plates **42** and **44** are releasably interconnected by bolts **48** having handles **50** thereon. The purpose of these bolts and handles is to tightly clamp the mold **34** between the plates **42** and **44** of a press. Constructed on each plate **42** and **44** is a heating element **52** and **54**.

The press **46** includes a prime mover housing **56** which causes rotation of shaft **58** located thereon and rotation of shaft **60** which interconnects plate **44** with the housing and prime mover located in the housing **56**.

The mold **34** being tightly clamped between plates **42** and **44** in the manner as illustrated in Fig. 6 is then caused to be rotated 90° by rotation of shaft **58** to that position illustrated in Fig. 7 of the drawings. In the last-mentioned position shaft **58** then ceases to rotate and shaft **60** is caused to slowly rotate. The slow rotation of shaft **60** results in the liquid polyvinyl chloride plastisol and graphite flowing from section **32** of the mold around the cavity **62** of section **38** in the manner, as illustrated in Fig. 4 of the drawings. While the polyvinyl chloride plastisol and graphite mixture is flowable, it does not flow very readily. Consequently, as illustrated in Figs. 3 and 4, when the mold cavity is in its horizontal position as distinguished from the upright position shown in Figs. 1 and 2 some, but not all, of the polyvinyl chloride plastisol flows from that part of the mold which is designed to mold the outer end of the ear stopper into that part of the mold designed to mold the inner end of the ear stopper. Much of the material tends to remain in the mold cavities in the section **32** and, consequently, the wall thickness of the ear stopper at the outer end thereof will be thicker and, consequently, stiffer when the material is ultimately cured. The coating of material that is applied to the walls of the mold cavity in the section **38** is quite thin and will become evenly distributed while the mold cavity and its contents are being rotated in the horizontal position. The walls of the inner end of the ear stopper will, consequently, be quite thin and highly flexible.

While the mold **34** is slowly being rotated heat is being applied to the mold by heating elements **52** and **54** to cause a "coagulation" of the polyvinyl chloride plastisol and graphite. The mold **34** is rotated and heated in order to obtain a complete coagulation of the ingredients **30**. Although only one portion of the mold is illustrated for forming an ear stopper, it is to be understood that there is provision in each mold for molding any number of ear stoppers **10**.

At the completion of the rotating and heating step, the mold **34** is removed from the rotary press **46** and placed in a conventional stationary press in order to obtain a "curing" of the ingredients **30**. This press is usually maintained at a temperature of 350° F. until the polyvinyl chloride plastisol is cured.

Between inserting the mold **24** into the press **46** and the second press a gas is formed by the ingredients heating and rotating which is entrapped in the chamber **14** of the envelope **12** of ear stopper **10**. The gas, as aforementioned, maintains the ear stopper **10** in an inflated condition and enables the ear stopper **10** to assume a tight fit in the external canal **26** of the ear **18**.

Various changes may be made in the details of construction without departing from the spirit and scope of the invention as defined by the appended claim.

I claim:

The method of making ear stoppers which consists of placing a flowable, heat-curable material in that part of a two part mold which is to mold the outer end of the ear stopper while that part of the mold is in an upright position, closing the mold by applying thereover the other part of the mold which is to mold the inner end of the ear stopper, turning the mold from its upright position to its horizontal position, rotating the mold while in the horizontal position whereby some of the material will flow from the first-mentioned part of the mold into said other part of the mold to coat the walls of its portion of the mold cavity with a thin layer, heating the mold while thus rotating to coagulate the material, and thereafter curing the material by heat whereby due to the fact that only part of the material flows from the first-mentioned part of the mold into said other part, the other end of the stopper will have a thicker wall than the inner part of the stopper and the stopper will be hollow except for gases which may be confined therein.

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