July 30, 1968 G. R. CALKINS 3,394,698

EAR NOISE SUPPRESSOR AND SPEECH CLARIFIER

Filed Sept. 29, 1964

FIG. 1

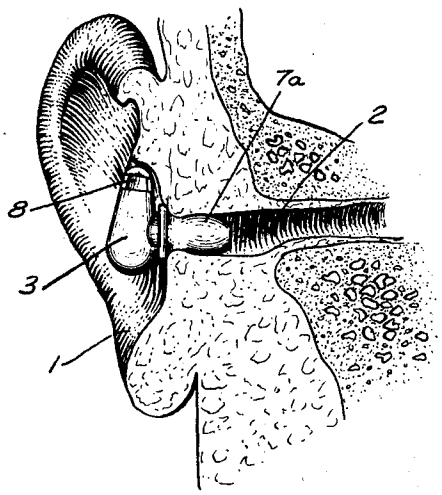


FIG. 2

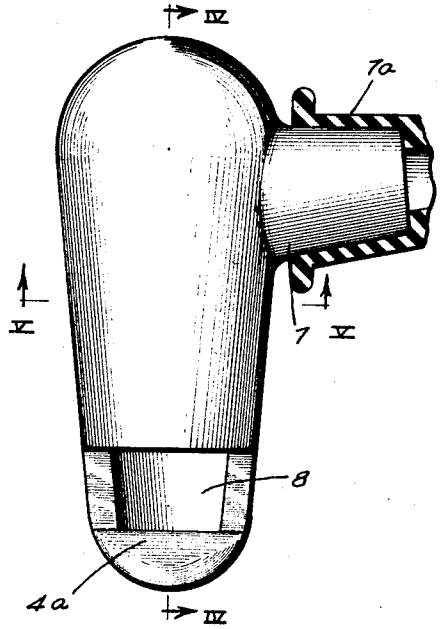


FIG. 3

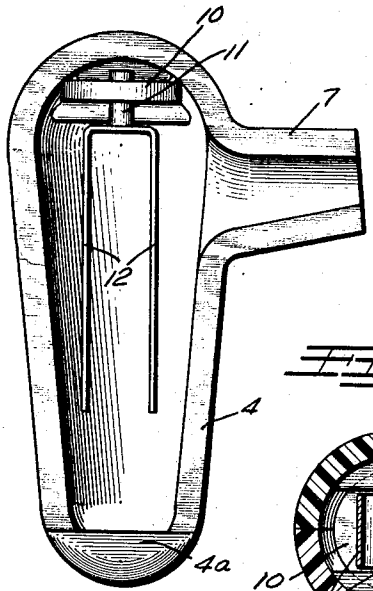


FIG. 4

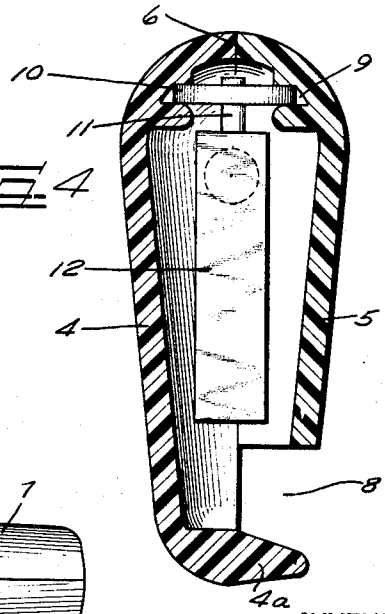
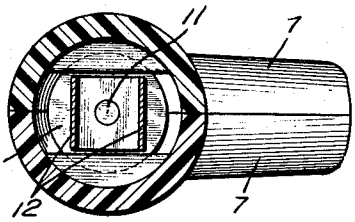


FIG. 5



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EAR NOISE SUPPRESSOR AND SPEECH CLARIFIER

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3 Claims. (Cl. 128—1)

ABSTRACT OF THE DISCLOSURE

A hearing device adapted to be worn in the external ear and having a chambered casing, an inlet in the casing open to external atmosphere and an outlet in the casing adapted to communicate with the auditory canal of the wearer, a tuning fork mounted within the casing and responsive to external audio-frequency vibrations, and a member adapted to contact the inner wall of the auditory canal of the wearer and affording open communication between the interior of the casing and the auditory canal to suppress undesirable internal head noises.

This invention relates to apparatus which is effective in suppressing internal sounds or noises which cause great annoyance and discomfort to persons afflicted therewith and which frequently interfere with the clear transmission of desired auditory signals in the case of those so afflicted.

The present invention involves the changing of frequencies of ambulatory sounds emanating either outside or inside of the ear to a relatively narrow band of constant frequency at either higher or lower frequencies than those at which the internal sounds occur. This is accomplished by the use of a carefully calibrated subminiature tuning fork positioned in the path of the entrance of ambulatory external sounds and in communication with the auditory canal of the ear so that the suppressor frequency will be imposed upon the auditory organs. The tuning fork selected for this purpose depends upon the character of the internal sounds to be suppressed and this invention contemplates the use of subminiature tuning forks identified in the first harmonic only at frequencies of from 62.5 c.p.s. to 8,000 c.p.s., the individual tuning forks within this range varying at increments of 100 cp.s. This enables the selection of an instrument incorporating a tuning fork of desired frequency to accomplish suppression of internal sounds occurring in a wide range of individual cases.

The acoustical suppressor of head sounds of this invention takes advantage of the critical band function where the masking of a pure tone by any given sound depends only on the total acoustic power operating within one-half of the critical band on either side of the frequency of the pure tone. The subjective pure tone generated in persons with sounds internal to the head will follow the critical band function because each critical band corresponds to a constant distance along the basilar membrane. Therefore, the origin of the signal (external or internal) will not alter the masking or suppressing effectiveness of any given sound.

It is an important object of this invention to provide apparatus for installation in the external ear in communication with the auditory canal for generation of an audible sound of predetermined fixed frequency effective to suppress undesirable internal head noises.

It is a further object of this invention to provide apparatus for the suppression of internal head sounds wherein the generator of a band of constant frequency is decoupled or insulated from a carrying casing whereby the same is mounted in the external ear.

It is a further object of this invention to provide a device for the suppression of internal head sounds which is so dimensioned as to provide the desired acoustical relationship between a tuning fork generator of the suppressing band and the chamber within which it operates.

It is finally an important object of this invention to provide apparatus for the suppression of internal head sounds which is simple in construction, constant in operation and which may be comfortably worn in the external human ear in effective communication with the auditory canal.

Another important object of this invention resides in the provision of apparatus of the kind described which in effecting suppression of undesirable internal head sounds at the same time in many instances tends to clarify and make more intelligible speech signals received by the ear of the wearer.

Other and further important objects of this invention will be apparent from the following specification in which there is described a preferred exemplary embodiment of this invention.

The invention (in a preferred form is shown on the drawings and hereinafter more fully described.

On the drawings:

FIG. 1 is a sectional view of a human ear showing the external ear and a portion of the auditory canal and showing a device incorporating the present invention in operative position therein.

FIG. 2 is an elevation view of a device incorporating the present invention and view from the side of the device having the entrance opening.

FIG. 3 is an elevational view of one of the mating portions showing the internal mounting of the subminiature tuning fork.

FIG. 4 is a section on the line IV—IV of FIG. 2.

FIG. 5 is an enlarged section on the line V—V of FIG. 2.

As shown on the drawings:

The device of this invention is adapted to be worn in the external ear (or ears) of a human and is provided with an integral cushioned projection which extends into the auditory canal communicating with the external ear.

In FIG. 1, the external ear is designated by the reference numeral **1** and the auditory canal by the reference numeral **2**. The device of this invention is mounted within the human ear as generally illustrated in FIG. 1 and said device will be described in detail hereinafter.

The instrument incorporating the present invention is carried within a chambered casing, preferably made of plastic or other non-vibratory material and generally designated by the reference numeral **3** in FIG. 1. The chambered or hollow casing **3** is preferably made of mating portions **4** and **5** having abutting portions which may be joined together on a mating line **6**. Each of the mating portions **4** and **5** has an integral projection **7** and when these mating portions are secured together, said projection **7** affords open communication between the interior of the casing and the auditory canal **2**.

An entrance opening **8** into the casing is provided by foreshortening the mating portion **5** as shown in FIGS. 1, 2 and 4 and this entrance opening is further defined by an end extension **4a** on the mating portion **4**. Each of the mating portions is provided with lateral recesses **9** (FIG. 4) and these recesses **9** serve to securely position a tuning fork mounting member **10** within the interior of the casing when the portions are assembled and secured together in any suitable way as, for example, by means of a plastic cement. The tuning fork mounting member **10** affords a base for the handle member **11** of a subminiature tuning fork having the usual vibrating prongs **12**, the open ends of which are adjacent but inside of the inlet **8**. As will be noted, this tuning fork is of small size, the maximum dis-

tance from the open end of the prongs to the fork base ordinarily not exceeding twelve millimeters and the maximum distance between the fork prongs ordinarily not exceeding three millimeters. As is well known, due to the adjacency of the prongs on a tuning fork, a substantially pure constant frequency note is provided upon excitation thereof and secondary or nodal harmonics are substantially eliminated.

In order to assure comfortable installation of the device and a sealing between the projecting member **7** with the entrance to the auditory canal **2**, the projecting member is provided with a resilient covering of soft rubber or plastic having an open inner end and frictionally engaging the outer surface of the projecting member **7**. This cushioning member is designated by the reference numeral *7a* and is shown in FIGS. 1 and 2.

As a guide to dimensional relationships, it should be noted that the maximum inside diameter of the entrance to the auditory canal is from five millimeters to six millimeters and in order to properly position the device for maximum operation, it is desirable that the relationship of the axes of the chambered main casing and of the passage through the projection **7** deviate from a right angle relationship by approximately ten degrees.

It is to be understood that in fitting this device for the suppression of individual undesirable internal head sounds, specific tuning fork ratings are employed for each individual case. It has been found by experience that a tuning fork having a laboratory rate of 300 c.p.s. tends to suppress or eliminate internal head sounds in many cases. However, a test may be made by the use of different tuning forks starting at 62.5 c.p.s. and using different tuning forks at increments of 100 c.p.s. up to 8,000 cycles per second (c.p.s.) and within this range it is usually possible to select a tuning fork most effective for suppressing individual internal head sounds in different individuals.

The phenomenon whereby the device of my invention is effective in suppressing or minimizing undesirable internal head sounds is not fully understood. It is believed, however, that the imposition of a continuous note at a selected frequency may tend to counteract vibrations causing certain of such sounds. It is possible that the imposition of this continuous note upon the vibrations causing the internal head sounds may tend to create an inaudible "beat." It has been found, however, that by selection of a proper tuning fork, the instrument of this invention is extremely effective in minimizing or completely suppressing annoying internal head sounds.

It has also been found that the suppression of such undesired head sounds results in hearing clarification in many instances.

I am aware that details of construction may be varied without departing from the principles of this invention and I therefore do not propose limiting the patent granted hereon otherwise than indicated by the scope of the appended claims.

I claim as my invention:

1. A hearing device adapted to be worn in the external ear and having a chambered casing, an inlet in the casing open to external atmosphere and an outlet in the casing adapted to communicate with the auditory canal of the wearer, wherein the improvement comprises:

a tuning fork mounted within said casing and responsive to external audio frequency vibrations to produce mechanical vibrations of a frequency to counteract the frequency of undesirable head noises, and

a member adapted to contact the inner wall of the auditory canal of the wearer and affording open communication between the interior of said casing and the auditory canal,

whereby undesirable internal head noises are suppressed.

2. A hearing device is recited in claim **1**, wherein said tuning fork is mounted on a shelf formed in said casing.

3. A hearing device as recited in claim **1**, wherein said member adapted to contact the inner wall of the auditory canal includes a projecting member and a cushioning member which frictionally engages the outer surface of said projecting member.

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