

[54] **DIRECTIONAL HEARING AID WITH VARIABLE DIRECTIVITY**

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[58] Field of Search **179/107 FD, 107 E, 107 R, 179/107 H, 1 DM**

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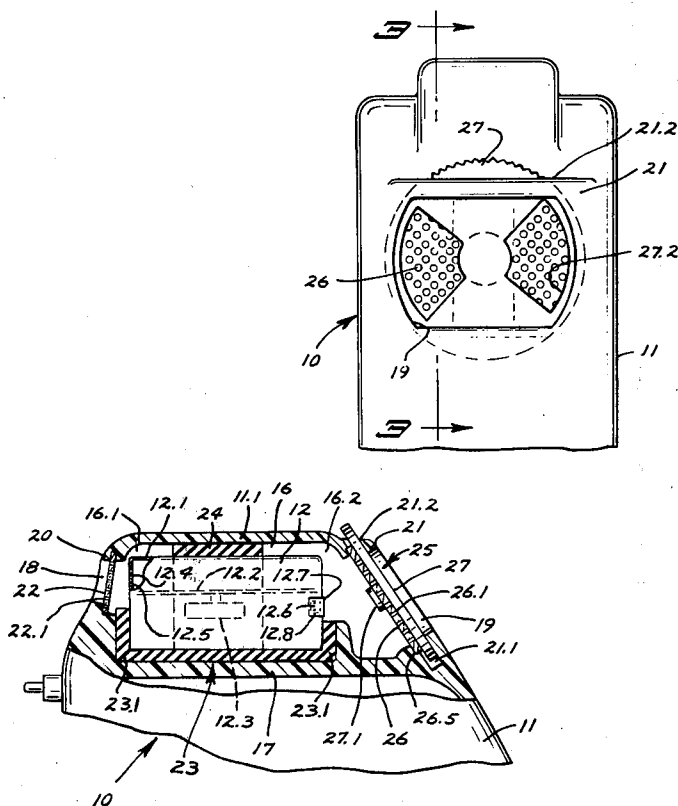
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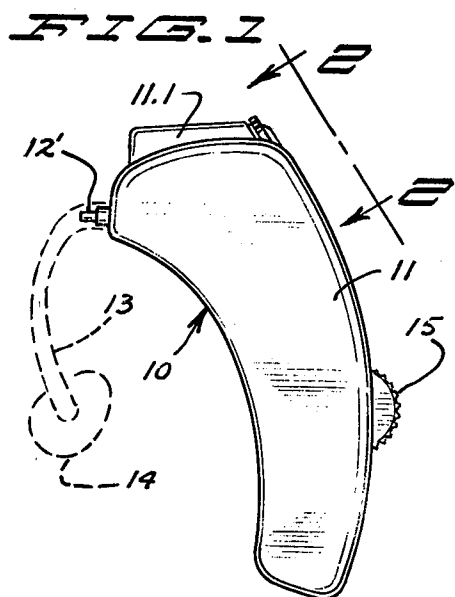
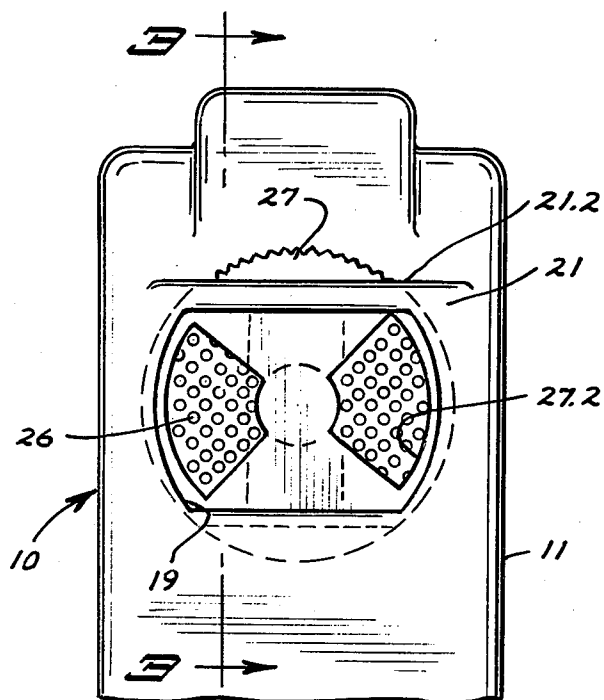
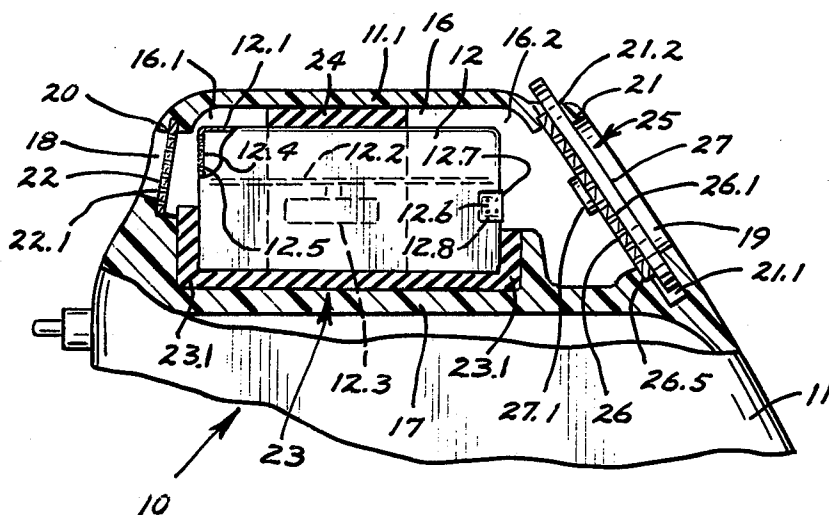
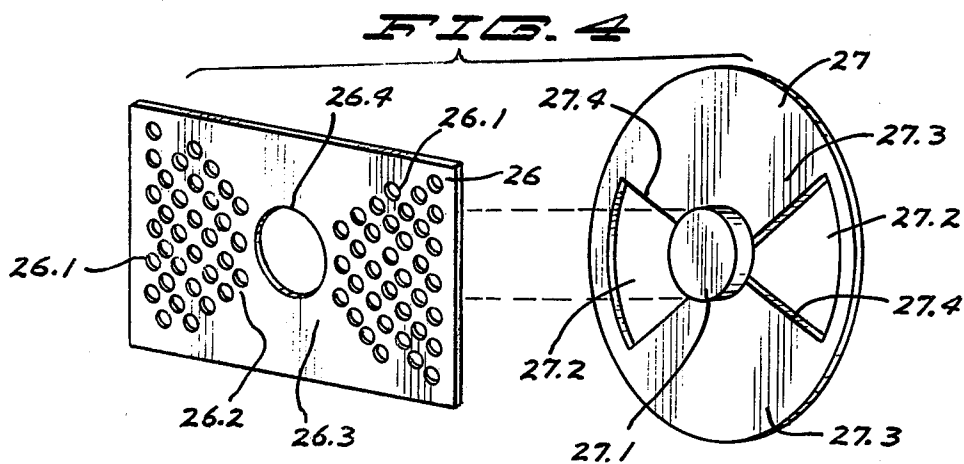
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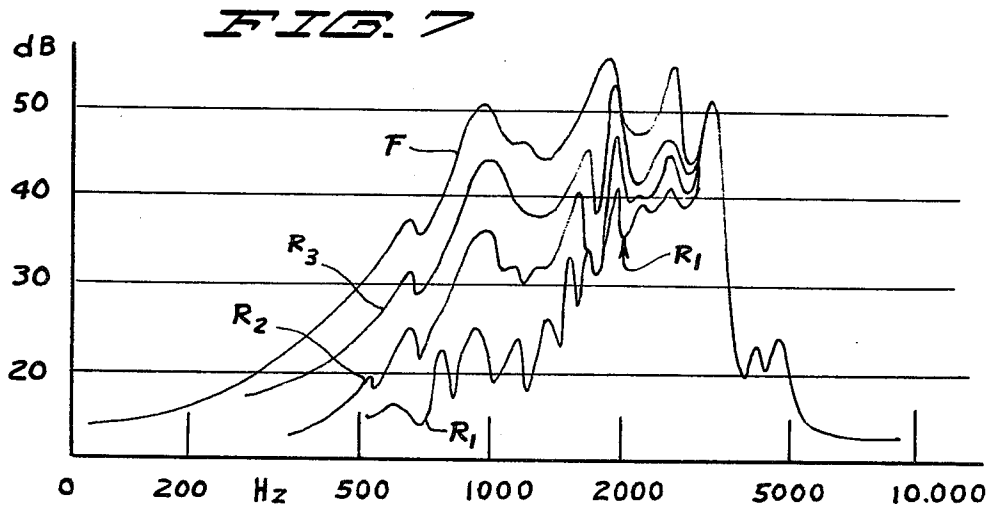
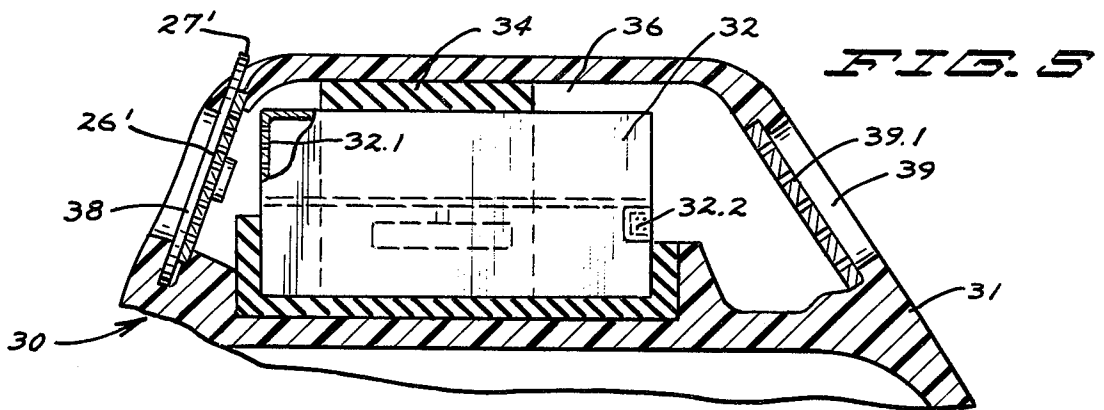
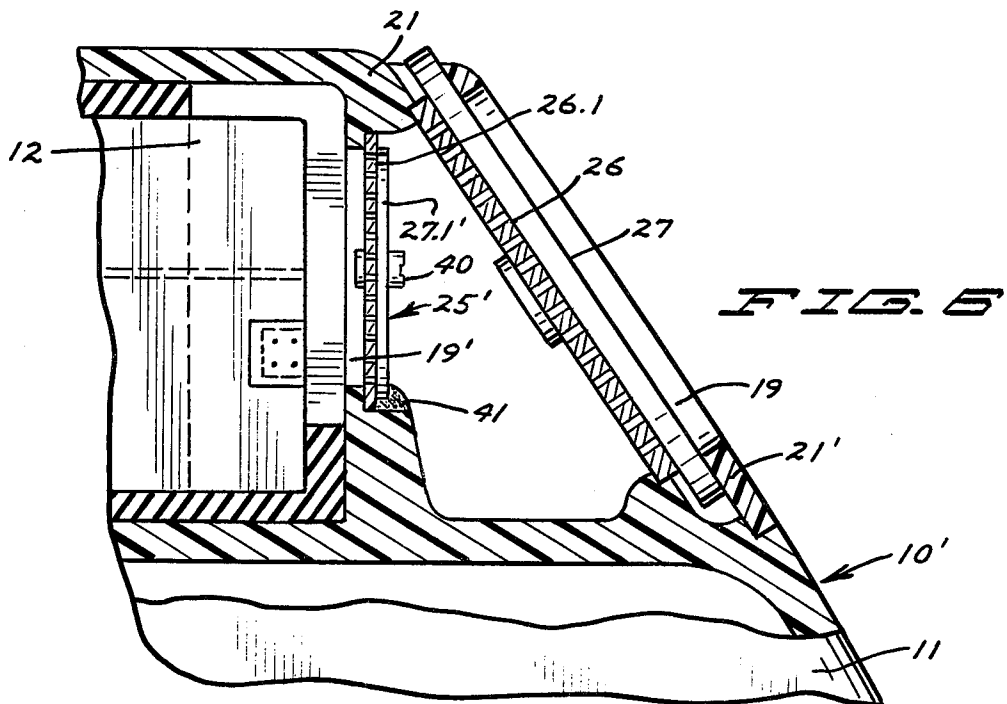
[57] **ABSTRACT**

A directional hearing aid to be fitted to a person's head and wherein the housing has front and rear openings to receive sounds from the front and rear, a directional microphone in the housing respectively receiving the sounds from front and rear, and a variable acoustic resistance in one of the openings of the housing, the acoustic resistance comprising a grill entirely filling the opening and having minute soundreceiving apertures, and a rotary plate having partly open areas to variably open and close the apertures of the grill for changing the acoustic resistance and changing the directivity effect of the directional hearing aid.

13 Claims, 7 Drawing Figures







DIRECTIONAL HEARING AID WITH VARIABLE DIRECTIVITY

BACKGROUND OF THE INVENTION

In a directional hearing aid of the type disclosed in U.S. Reissue Patent RE 27,487, it is important that sound be admitted at both the front and rear of the housing so as to supply sound to both sides of the diaphragm in the microphone. Ordinarily, an acoustic resistance is incorporated at the rear of the microphone so as to introduce a time delay or phase shift in the transmission of sound waves to the diaphragm which enter the rear of the microphone, as compared to those which enter, unimpeded, at the front of the microphone. Thus, as for sounds which originate in front of the microphone, such a phase shift causes sound waves entering the rear of the microphone to have an additive effect in moving the diaphragm along with the sound waves entering the microphone from the front. This additive effect is in contrast to the neutralizing effect of sound waves originating from the rear and reaching the opposite sides of the diaphragm simultaneously to thereby oppose each other and prevent the diaphragm from moving. Of course, this additive effect is transformed into a larger magnitude of signal from the microphone.

The microphone with the acoustic resistance at the rear of the microphone responds to sound originating from a location to the rear of the microphone so as to produce more of a neutralizing effect as the sound waves are applied at opposite sides of the diaphragm so that the diaphragm has less magnitude of movement and generates a lesser magnitude of signals for output from the microphone than in the case of sounds which originate from in front of the microphone.

It has been found that the amount of the resistance at the rear of the microphone is rather critical, and that the directional response of the microphone and the hearing aid in which the microphone is incorporated will peak at a rather small range of acoustic resistance, and if the acoustic resistance is either increased or decreased out of such a small range, the directional characteristics of the microphone and hearing aid are considerably reduced.

It has also been determined that the relative magnitude of the acoustic resistance at the rear of the microphone to the resistance at the front of the microphone at the openings into the microphone for admitting sound waves to opposite sides of the diaphragm is important. As a result, it may be desirable in certain instances to apply an acoustic resistance in relation to the opening at the front of the microphone as well as some resistance in relation to the opening at the rear of the microphone so that the combination of acoustic resistances is such as to maximize the directional effect of the microphone and the ability of the microphone to maximize its signal response on sounds which originate from a location in front of the microphone as compared to the signal response on sounds which originate from the rear of the microphone.

In setting the acoustic resistances in relation to a microphone for a hearing aid, it will be recognized that the rather tiny parts that are being used and the tiny spaces in which the parts are located in the hearing aid housing make it extremely difficult to exactly reproduce all of the parts and their relationships and exactly

reproduce the acoustic resistances in each microphone and hearing aid and make them the same as in all other of these tiny microphones and hearing aids. It is also to be recognized that various persons wearing hearing aids can tolerate or desire various degrees of directivity in the hearing aid.

SUMMARY OF THE INVENTION

The present invention relates to apparatus to vary the directivity response of a hearing aid, and this is accomplished by varying the combination of acoustic resistances to admission of sounds at the front and rear of the microphone and hearing aid housing. The microphone has access ports for sounds to enter from the front and rear and a resistance is defined at the rear of the microphone to establish a directional effect, without regard to the hearing aid housing. An additional acoustic resistance with minute clear passages is provided in the ports of the hearing aid housing through which the sound waves are permitted to pass to the front and rear of the microphone.

In many cases, the variable acoustic resistance is disposed in the passage of the hearing aid housing which supplies sound waves to the rear of the microphone, but, in order to change the combination of acoustic resistances which are effective to change the directivity effect of the unit, a variable acoustic resistance may be established adjacent the front of the microphone.

Use of these adjustable acoustic resistances will vary the combination of resistances in the directional hearing aid so that the hearing aid can be tuned to its maximum directional characteristic or to such other directional characteristics as may be comfortable to or desired by the wearer of the hearing aid.

The acoustic resistances may be controllable from the exterior of the hearing aid housing, or may be controllable or variable only by obtaining access into the interior of the hearing aid housing. Ordinarily, the wearer of the hearing aid does not have access to the interior of the hearing aid housing but technicians, who are familiar with hearing aid features, find it very useful to be able to tune a directional hearing aid to its maximum directivity and this may be accomplished by a variable acoustic resistance confined wholly within the housing of the hearing aid. An additional variable acoustic resistance may be provided for reducing the directional effect of the hearing aid unit and may be controllable or adjustable by the wearer of the hearing aid or by a person who is capable of fitting the hearing aid to the wearer.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is an elevation view of a behind the ear hearing aid which incorporates the present invention.

FIG. 2 is an elevation view taken at an oblique angle as indicated at 2—2 in FIG. 1 showing the rear detail of the hearing aid housing.

FIG. 3 is an enlarged detail section view taken approximately at 3—3 in FIG. 2.

FIG. 4 is an exploded perspective view of certain important parts of the variable acoustic resistance of the hearing aid.

FIG. 5 is an enlarged detail section view somewhat similar to FIG. 3 and showing a modified form of the invention.

FIG. 6 is a greatly enlarged detail section view somewhat similar to FIG. 3 and showing an additional modified form of the invention.

FIG. 7 is a response curve showing the gain in output signal produced by the hearing aid illustrated in FIGS. 1-4; curve F shows the gain produced by the hearing aid in relation to sounds originating at a location in front of the hearing aid; and curves R₁, R₂ and R₃ show the response characteristics to sounds originating at a location to the rear of the hearing aid, and wherein curve R₁ illustrates the response in the condition wherein the variable acoustic resistance is at a minimum, and curve R₃ illustrating the response in the condition wherein the variable acoustic resistance is at nearly a maximum, and curve R₂ illustrates the response of the hearing aid in the condition wherein the variable acoustic resistance is of intermediate magnitude.

DETAILED DESCRIPTION OF THE INVENTION

The form of the invention illustrated in FIGS. 1-4 is a behind-the-ear hearing aid, indicated in general by numeral 10 and having a housing 11 which confines all of the hearing aid components including the microphone 12 as well as the circuitry, the battery, the sound producing transducer from which sound is transmitted through the nipple 12' to which the sound tube 13 and ear mold 14 are connected. The volume of the output may be regulated by the volume control 15.

The hearing aid housing 11 defines an isolated microphone chamber 16 which is separated from the other portions of the interior of housing 11 by a full wall 17 which minimizes any transmission of sounds therethrough. Sounds are permitted to enter the front and rear portions of the microphone chamber 16 through access ports 18 and 19 formed in the front and rear wall portions 20 and 21, respectively, of the housing 11 which defines the microphone chamber 16. The front port 18 has a protective grill 22 secured therein as by adhesive or otherwise to protect the microphone 12 and prevent foreign materials or articles from entering or obstructing the access port or opening 18. The apertures 22.1 in the grill 22 are sufficiently large and numerous as to cumulatively provide open space which is essentially non-resistive to transmittal of sound therethrough.

The microphone 12 is confined in the chamber 16 and physically located by a soft and resilient spacer pad 23, which underlies the microphone and has upright ends 23.1 to cushion the ends of the microphone. Pad 23 has a belt portion 24 surrounding the girth area of the microphone 12. Pad 23 including the integral belt portion is constructed of soft and resilient sound absorbing material such as soft porous rubber or plastic so as to substantially completely isolate the front portion 16.1 of the microphone chamber from the rear portion 16.2 thereof and thereby prevent any migration of sound around the exterior of the microphone and between the front and rear portions of the microphone chamber. The pad 23 with belt 24 of resilient material also confines the microphone 12 against movement in the chamber 16 because the pad and belt engage both the case 12.1 of the microphone and the adjoining wall areas 17 and 11.1 of the hearing aid housing.

The microphone 12 has a diaphragm 12.2 and a transducer 12.3 which is operated by the diaphragm. The diaphragm 12.2 separates the microphone case

into two separate compartments so that sounds entering both compartments will apply pressures against the diaphragm so as to cause oscillation or vibration thereof. The upper compartment in the hearing aid case communicates with a sound-receiving opening 12.4 disposed at the front portion of the microphone and specifically in the front wall 12.5 thereof. In this form, the sound-receiving opening 12.4 is essentially non-restrictive or non-resistive to passage of sounds therethrough so that the sounds and sound pressure variations may enter the upper compartment of the microphone substantially unimpeded. The upper compartment of the microphone will thereby receive sounds from the front port 18 of the hearing aid housing.

The lower compartment of the microphone 12 has one or more sound-receiving openings 12.6 located adjacent the rear portion of the microphone case 12.1 at a location below the diaphragm 12.2. In the form shown, the openings 12.6 are minute in size and are formed in a separate plate 12.7 secured over a large opening 12.8 formed in the rear portion of the hearing aid case at a location below the diaphragm 12.2. The openings 12.6 are extremely small and may be formed by etching or similar processes so that the size of the openings 12.6 form an acoustical resistance between the interior of the microphone and the rear portion 16.2 of the microphone chamber. As previously described, the resistance provided by the openings 12.6 to passage of sounds into the microphone cause a phase shift or delay in transmission of these sounds relative to the transmission of sounds into the front portion of the microphone.

The amount of resistance provided by the openings 12.6 into the microphone case is rather critical. The directivity of the microphone 12 and of the hearing aid will be at a maximum for a rather narrow range of resistances provided by the minute openings 12.6, and if the amount of resistance provided for entry of sound into the rear portion of the microphone is varied from such a small range, by either increasing the resistance or decreasing the resistance, the directivity effect of the microphone and hearing aid will be reduced considerably.

Because of the criticality of the amount of resistance as it affects the directivity of the unit, it may be desirable to tune each hearing aid to the maximum directivity, or at least to the level of directivity which is desired.

The hearing aid 10 is provided with a variable acoustic resistance 25 in the access opening or port 19 in the rear wall 21 of the hearing aid housing. The variable acoustic resistance includes a grill or screen 26 having a plurality of minute apertures or clear passages 26.1 therein (which are illustrated disproportionately large in the drawing as to be visible) for permitting passage of sound therethrough. The apertures 26.1 cumulatively define an open area through the grill 26 which has essentially no resistance to transmission of sounds and sound waves therethrough, but the apertures 26.1 are sufficiently small as to define a significant resistance to transmission of sounds therethrough when most of the apertures 26.1 are closed or covered and only a few of the apertures remain open.

The resistance 25 in combination with the volume of chamber 16.2 produce the phase shift or delay of sounds entering the rear port 19 of the hearing aid. The space in chamber 16.2 is fixed and acts in a manner

similar to a capacitance in electrical circuitry. Adjusting the resistance 25 effects tuning so as to maximize, or vary, the phase shift of sounds entering the rear port 19. Similarly, the resistance provided by minute openings 12.6, in combination with the space within the microphone case 12.1 and beneath the diaphragm produces a phase shift or delay of sounds entering the microphone from the time such sounds are first presented at the openings 12.6 and until such sounds are effective to produce an effect upon the diaphragm.

The variable acoustic resistance also includes a substantially circular disc or masking plate 27 having a cylindrical hub 27.1 which fits snugly into the bearing opening 26.4 of the grill plate and is rotatable in the opening. The masking plate 27 will lie flush against the grill plate 26 which is sealed around its entire peripheral edge 26.5 to the rear wall of the microphone chamber. The masking plate or disc 27 is disposed in a slot 21.1 in the rear wall of the housing and the upper portion of the disc 27 protrudes outwardly through an open side 21.2 of the slot.

The masking disc or plate 27 has a pair of openings 27.2 formed therein and also a pair of adjacent closed areas 27.3 separated from the open areas by substantially radial edges 27.4.

The boundary 26.2 of area of apertures 26.1 in the grill is similar in shape to opening 27.2 of wheel 27 so that the resistance can be maximized by closing all of openings 26.1.

The masking plate or disc 27 may be rotated by manual manipulation of the edge which protrudes through the side of slot 21.2, and the plate 27 will progressively cover or uncover portions of the apertured areas of the grill 26 so as to progressively increase or decrease the resistance to transmission of sound to the rear portion of the microphone.

The curves in FIG. 7 illustrate the operating characteristics of the hearing aid 10 at various adjustments of the rotary masking plate or disc 27 of the variable acoustic resistance. The microphone 12 of the hearing aid 10 was turned so that as relates to sounds which originate at a location in front of the hearing aid housing, the gain recorded at the output of the hearing aid in such sounds was at a maximum as indicated by the curve F in FIG. 7. Subsequently, the hearing aid was reversed so that the sound was originating at a location to the rear of the hearing aid, closest the access port 19. With the masking plate 27 in the adjustment illustrated in FIG. 2 wherein the maximum number of openings 26.1 of the grill are open and therefore the least resistance to transmission of sounds is encountered, the gain produced by the hearing aid was recorded at the curve R₁. At 1000 Hz. the gain with the sound originating at the front of the hearing aid was approximately 50 dB, and the gain with the sound originating to the rear of the hearing aid was approximately 23 dB, and therefore the differential front to rear gain was 27 dB, which indicates that, at this setting, the hearing aid had a maximum directivity effect. In other words, the hearing aid was most sensitive to sounds originating at a location in front of the hearing aid and least sensitive to sounds originating at the rear of the hearing aid.

The resistance produced by the variable acoustic resistance 25 was thereafter increased at several different settings as depicted by the characteristics recorded in curves R₂ and R₃. The differential gain, front to rear, between the curves R₂ and F was only moderate, and

at 1000 Hz., the differential gain, front to rear, was 15 dB, still significant, but of moderate magnitude.

With the masking plate 27 rotated so that substantially all of the apertures in grill 26 are closed, the curve R₃ was recorded with the sound originating from a location to the rear of the hearing aid, and it will be seen that the least differential gain, front to rear, was recorded for this setting of the masking plate 27. In this condition, only a 6dB differential gain was determined at 1000 Hz.

It will be noted in the curves of FIG. 7, that curves R₂ and R₃ are merged with curves R₁ and F and that the overall effect of the variable acoustic resistance 25 is nullified as the frequencies approach 5000 Hz.

However, in the normal voice ranges, in the vicinity of 500 to 2000 Hz., the effect of the variable acoustic resistance 25 is pronounced.

With the original tuning of microphone 12, the adding of additional acoustic resistance by the variable acoustic resistance 25 tends to decrease the directivity effect of the hearing aid. However, the microphone 12 may have been tuned so that the acoustic resistance provided by the minute clear passages 12.6 into the rear portion of the housing, may have produced slightly less than maximum directivity of the hearing aid, whereupon the variable acoustic resistance 25 may have first caused the differential gain to increase and then subsequently decrease as the variable acoustic resistance 25 produces more resistance by closing more and more of the apertures 26.1.

In the form of the invention illustrated in FIG. 5, the hearing aid 30 has a housing 31 very nearly identical to the housing previously described. The microphone chamber 36 confines the microphone 32 and the resilient belt 34 isolates the front and rear portions of the microphone chamber from each other. The port 39 in the rear wall of the housing has a simple protective grill 39.1 to protect the microphone from exterior influences, but to freely transmit sounds therethrough without significant resistance. The microphone 32 has a forwardly facing sound-receiving opening 32.1 of sufficient size as to be non-resistive to transmission of sounds therethrough. The sound-receiving openings 32.2 in the rear portion of the microphone and communicating with the lower microphone compartment beneath the diaphragm are resistive to transmission of sounds.

An apertured grill 26', substantially identical to the grill 26 described in connection with FIGS. 1-4 is secured about its entire periphery to the hearing aid housing in the front port 38 with the capability of increasing the resistance to sounds transmitted to the front of the microphone if a number of the apertures in the grill 26' are closed or covered. This resistance in combination with the chamber 16.1, produces a phase shift or delay of the sound before its effects movement of the diaphragm. A rotatable disc or masking plate 27' is rotatably mounted on and lies flush against the apertured grill 26' in the same identical fashion as is the grill 27 related to the grill 26 in the form of the invention illustrated in FIGS. 1-4. The openings in the masking plate or disc 27' may partially cover and uncover the apertures in the grill 26' as the plate 27' is revolved. The changing of the resistance to transmission of sounds into the front of the microphone 32 will vary the degree of directivity effect of the hearing aid because of a delay in transmission or phase shift of the sounds

entering through the front of the hearing aid as well as those entering into the rear of the microphone.

In FIG. 6, the form of the hearing aid 10' is substantially identical to that illustrated in FIGS. 1-4 with certain exceptions. The microphone 12 is the same and is located essentially identically to that previously described. The rear wall 21' of the hearing aid housing partly is partially defined by a cover 21' in this form of the invention, and it is the cover 21' of the rear wall through which the rear access opening 19 is defined. The rotatable masking disc 27 and the apertured grill 26 are both identical to that illustrated in FIGS. 1-4 and are related to each other in the same manner and function in the same manner as previously described.

In this form of the invention illustrated in FIG. 6, the access port has an interior portion 19' thereof in which an additional variable acoustic resistance 25' is located. The variable acoustic resistance 25' has an apertured grill 26.1', and a partly open rotary masking plate or disc 27.1', both of which are substantially identical to the grill and masking disc 26, 27, respectively, but of slightly smaller dimensions. In addition, the rotatable masking plate 27.1 has an operating control lug 40 located at its center and provided with a screw driver slot so that the disc 27.1' can be adjusted to produce the directivity of the hearing aid 10', and then a spot of adhesive 41 will secure the edge of the plate 27.1' to the adjoining portion of the housing to retain it in a prefixed location. The disc 27 will then be used simply by the wearer or the person who fits the hearing aid to the wearer to produce the directivity which is comfortable for the wearer to utilize.

It will be seen that this invention provides a hearing aid with a directional microphone to receive the sounds from both front and rear, and an adjustable acoustic resistance to vary the amount of resistance to sounds being transmitted through one of the main access ports and into the hearing aid to control the relative gain to sounds originating from positions to the front of and to the rear of the hearing aid and thereby control the degree of directivity of the hearing aid. Although the drawings illustrate the invention applied to a behind-the-ear hearing aid, the invention is also applicable to hearing aids incorporated in eyeglasses.

What is claimed is:

1. In a directional hearing aid, a microphone containing a diaphragm and a transducer and having sound-receiving openings in the front and rear portions of the microphone case to transmit sounds to both sides of the diaphragm and to create a significant acoustic resistance at the rear portion of the microphone case and thereby effect a phase shift of the sounds entering through such rear portions,

a hearing aid housing shaped to fit a person's head and oriented in a fore and aft direction, the housing having a microphone chamber and front and rear wall portions with sound access ports transmitting sound into the chamber to the microphone, and a variable acoustic resistance in one of said sound access ports and operable to vary the gains relative to each other produced by the hearing aid of sounds originating, respectively, in front of and to the rear of the hearing aid and thereby change the directivity effect of the hearing aid.

2. The invention according to claim 1 and the acoustical resistance including a grill in the port, a masking plate lying against the grill and movable along the grill

for covering and uncovering portions of the grill to thereby change the acoustical resistance and vary the directivity of the hearing aid.

3. The invention according to claim 1 and the variable acoustical resistance having a movable part to be moved to vary the acoustical resistance, and said movable part having a control portion accessible from the exterior of the hearing aid housing for moving said part to vary the directivity of the hearing aid.

4. In a directional hearing aid, a microphone containing a diaphragm and a transducer and having sound-receiving openings in the front and rear portions of the microphone case to transmit sounds to both sides of the diaphragm and to create a significant acoustic resistance at the rear portion of the microphone case and thereby effect a phase shift of the sounds entering through such rear portions,

a hearing aid housing shaped to fit to a person's head and oriented in a fore and aft direction, the housing having a microphone chamber and front and rear wall portions with sound access ports transmitting sound into the chamber to the microphone, and

a variable acoustic resistance in one of said sound access ports and operable to vary the gains relative to each other produce by the hearing aid of sounds originating, respectively, in front of and to the rear of the hearing aid and thereby change the directivity effect of the hearing aid, the acoustical resistance including a grill in the port, a masking plate lying against the grill and movable along the grill for covering and uncovering portions of the grill to thereby change the acoustical resistance and vary the directivity of the hearing aid, the masking plate being rotatable and having alternate open and closed portions adjacent each other circumferentially of the plate to cover and uncover portions of the grill as the masking plate is rotated to progressively vary the directivity of the hearing aid.

5. The invention according to claim 4 and the rotatable masking plate having a rounded peripheral edge protruding through the housing to the exterior of the housing to facilitate manual rotation of the masking plate to vary the acoustical resistance and directivity of the hearing aid.

6. The invention according to claim 4 and the grill having adjacent areas, one being partially open and substantially more previous to passage of sound there-through than the other adjacent area, the closed portion of the masking plate moving across said partly open area of the grill to vary the acoustical resistance and the directivity of the hearing aid.

7. The invention according to claim 6 and the rotatable masking plate having a circular mounting hub fitting snugly in and rotatable with respect to an opening in the grill, and said rotatable masking plate lying flush against the grill to prevent sound from traveling transversely between the grill and masking plate.

8. The invention according to claim 5 and the grill and masking plate being disposed at the rear wall portion of the hearing aid housing and in the sound access port thereof to vary the resistance to sounds transmitted through the rear port of the hearing aid and to the microphone.

9. The invention according to claim 5 and the grill and masking plate being disposed at the front wall portion of the hearing aid housing and in the sound access

port thereof to vary the resistance to sounds transmitted through the front port and to the microphone.

10. In a directional hearing aid, a microphone containing a diaphragm and a transducer and having sound-receiving openings in the front and rear portions of the microphone case to transmit sounds to both sides of the diaphragm and to create a significant acoustic resistance at the rear portion of the microphone case and thereby effect a phase shift of the sounds entering through such rear portions,

a hearing aid housing shaped to fit to a person's head and oriented in a fore and aft direction, the housing having a microphone chamber and front and rear wall portions with sound access ports transmitting sound into the chamber to the microphone, and

a variable acoustic resistance in one of said sound access ports and operable to vary the gains relative to each other produced by the hearing aid of sounds originating, respectively, in front of and to the rear of the hearing aid and thereby change the directivity effect of the hearing aid, the variable acoustical resistance having a movable part to be moved to vary the acoustical resistance, and said movable part having a control portion accessible from the exterior of the hearing aid housing for moving said part to vary the directivity of the hearing aid, and a second variable acoustical resistance in one of the access ports to the hearing aid housing and having a manually operable control portion disposed wholly within the housing to restrict access thereto.

11. In a hearing aid,

a microphone containing a diaphragm and a transducer and having sound-receiving openings in the front and rear portions of the microphone case to transmit sounds to both sides of the diaphragm, the microphone having an acoustical resistance in the opening at the rear portions of the microphone case to delay the transmission of sounds through the openings in the rear portions of the microphone and thereby induce a directional effect in the microphone,

a hearing aid housing shaped to be fit against a person's head and oriented in a fore and aft direction, the housing having a microphone chamber and front and rear wall portions with sound access ports transmitting sound into the chamber to the microphone, the openings in the front and rear portions of the microphone case being disposed adjacent to, respectively, the front and rear wall portions of the housing with the front and rear access ports there-through, means within the housing preventing transmittal of sound from the rear access port of the hearing aid housing to the front soundreceiving opening of the microphone case and also preventing transmittal of sound through the microphone chamber from the front access port and to the sound-receiving openings at the rear of the microphone case,

a variable acoustic resistance in the sound access port in the rear wall portion of the hearing aid housing to change the directivity effect of the hearing aid, said variable acoustic resistance including a stationary grill in the rear access port, the grill having adjacent areas of different sound transmitting capabilities, one of said areas having a plurality

of closely spaced and minute apertures defining clear passages and cumulatively defining a substantial open area to provide minimum restriction and resistance to passage of sounds therethrough, said individual apertures being sufficiently small as to provide very substantial resistance, acting individually and alone, to passage of sound therethrough, the other of said areas adjacent to the apertured area having substantially less sound transmitting capability than said apertured area, the periphery of the grill being sealed to the hearing aid housing to prevent any passage of sounds around the edges of the grill and into the microphone chamber,

said acoustical resistance also including a rotatable masking plate in the rear sound access port of the hearing aid housing and lying flush against the grill, the periphery of the masking plate being disposed adjacent the periphery of the grill and preventing passage of sounds therebetween, the masking plate having alternate open and closed portions adjacent each other in a direction circumferentially of the plate to cover and uncover portions of the apertured area of the grill, the rotatable masking plate having a rounded edge portion protruding through the hearing aid housing and to the exterior thereof to facilitate manual manipulation of the masking plate which changes the acoustic resistance to sound entering through the rear port of the hearing aid housing to the microphone and change the gains relative to each other produced by the hearing aid of sounds originating, respectively, in front of and to the rear of the hearing aid, thereby changing the directivity effect of the hearing aid.

12. The invention according to claim 11 and the rotatable masking plate having an edge separating the open and closed portions thereof, said edge extending from the central area of the masking plate outwardly toward the edge thereof, and the apertured area of the grill having a boundary edge adjacent the other area of the grill and said boundary edge having an orientation oblique to the edge of the open area of the masking plate whereby to progressively and incrementally close the apertured area of the grill as the masking plate passes thereover.

13. The invention according to claim 11 and there being a second variable acoustic resistance in the sound access port of the rear wall portions of the housing defining the microphone chamber, said second variable acoustic resistance having a grill with its peripheral edge entirely engaging the housing and preventing passage of sounds into the microphone chamber and around said peripheral edge, the grill of said second acoustic resistance also having a plurality of minute sound transmitting apertures defining clear passages into the microphone chamber and also having an area adjacent said apertures for obstructing passage of sound through the grill of said second resistance, and the second resistance also having a movable masking plate lying flush against the grill and movable to progressively cover and uncover the apertures of the grill of the second sound transmitting resistance, and means confined within the housing for effecting movement of the masking plate of the second acoustic resistance.

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