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MOUTHPIECE MICROPHONE UNIT

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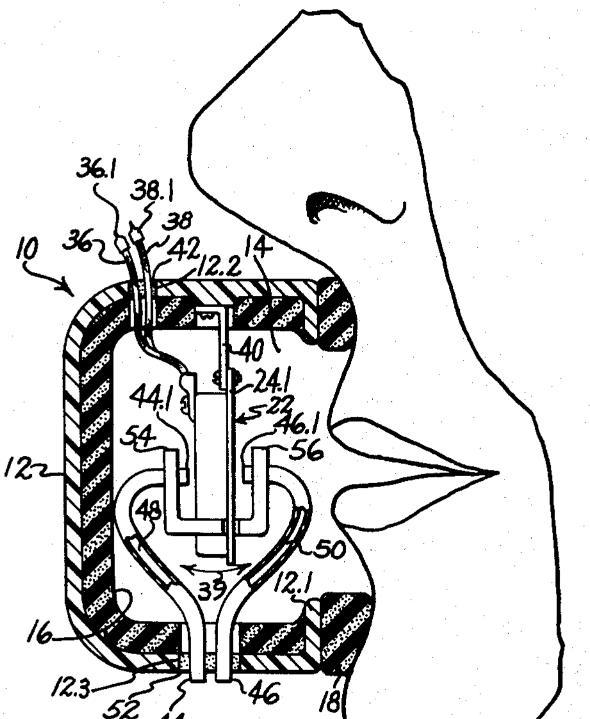

Fig. 1

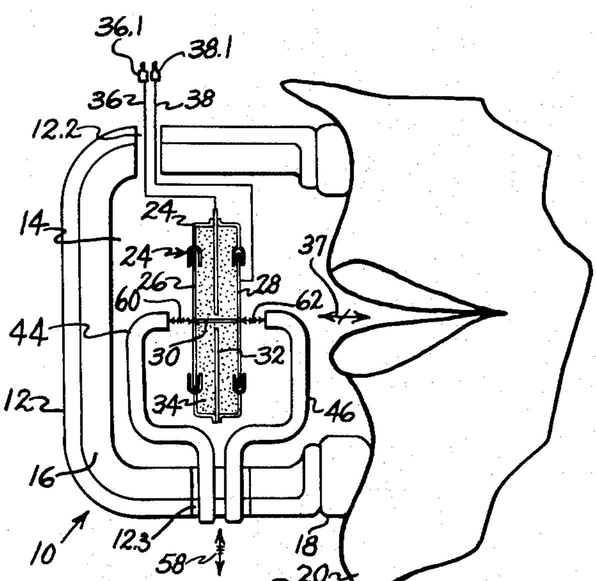

Fig. 2

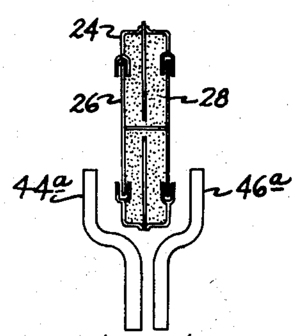

Fig. 3

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MOUTHPIECE MICROPHONE UNIT

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The field of this invention is that of microphones, and the invention relates, more particularly, to mouthpiece microphones which can be employed for voice-communication in environments characterized by high intensity noise levels of 100 decibels or more.

Conventional microphone means employed in radio and telephonic voice-communication and the like are frequently unsatisfactory under high intensity noise conditions in that the microphone means are not properly shielded from the effects of ambient noise. Under extreme noise conditions, such microphone means frequently cannot transmit voice communications with a suitable signal-to-noise ratio and as a result, communications under such conditions are often limited to the use of hand signals and the like.

It is an object of this invention to provide novel and improved microphone means; to provide such improved microphone means which can achieve improved signal-to-noise ratios in transmitting voice-communications under high intensity noise conditions; and to provide improved mouthpiece microphone means which can be conveniently and comfortably worn for long periods of time.

It is a further object of this invention to provide a mouthpiece microphone unit embodying a sound-shielding shell means which forms a cavity having an open end and which has a rim around said open cavity end adapted to fit in sealed relation to the face around the mouth of a unit operator. The unit also includes transducer means mounted within the shell cavity for converting sound waves or vibrations from the operator's voice into corresponding electrical voice signals, the transducer means including vibratory means such as a diaphragm unit or the like which is responsive to sound waves or wave pressures impinging on either of the opposite sides thereof for converting said sound waves or pressures into said electrical signals. The unit further includes conduit means forming air passages which extend from outside the shell means to respective opposite sides of the transducer vibratory means within the shell cavity. The air passages are primarily adapted to vent air expelled from the mouth during speaking from within the shell cavity but are also adapted to permit ambient noise waves or wave pressures transmitted therethrough to impinge upon opposite sides of the transducer vibratory means with equal amplitude and substantially in phase, thereby to cancel the effect of said noise vibrations or wave pressures upon said vibratory means.

Other objects, advantages and details of the microphone unit provided by this invention appear in the following detailed description of preferred embodiments of the invention, the detailed description referred to the drawings in which:

FIG. 1 is an axial section view through the mouthpiece microphone unit provided by this invention;

FIG. 2 is a diagrammatic view similar to FIG. 1 illustrating the function of the apparatus of FIG. 1; and

FIG. 3 is a partial diagrammatic view similar to FIG. 2 illustrating an alternative embodiment of this invention.

Referring to the drawings, 10 in FIG. 1 indicates the novel and improved mouthpiece microphone unit provided by this invention. As will be understood, such a microphone unit can be connected in a conventional radio or telephone communications circuit or the like and a person wishing to transmit voice-communications by means of said circuit can speak directly into the microphone unit in a manner to be further described below. For this purpose, the microphone unit illustrated in FIG. 1 can be manually held over the operator's mouth, but, if desired, the unit may be mounted upon a conventional head band or may be incorporated in a helmet or the like in a conventional manner. The person using the microphone unit will be referred to hereinafter as the microphone unit operator.

As illustrated in FIG. 1, the unit 10 includes a generally cup-shaped, sound-shielding, shell member 12 which forms an open ended cavity 14 of substantial size. The shell member can embody any suitably rugged metal or plastic material or the like and is preferably lined with a sound-absorbing material 16 such as polyurethane foam, sponge rubber or the like. The shell member can be flanged as at 12.1 around the rim of the open end of the cavity 14, and a yieldable cushion means 18 such as a ring of sponge rubber can be cemented or otherwise secured around the member flange in a conventional manner. In this construction, the open end of the shell member cavity 14 can fit around the mouth of the unit operator, indicated at 20, and the cushion means 18 can conform to the facial configurations of the operator for sealing the shell member cavity in substantially air-tight relation to the operator's face. It should be understood that the precise structure described above has been described only by way of illustration and that any similar sound-shielding shell or enclosure means adapted to form a cavity 14 and to fit in sealed relation around an operator's mouth is within the scope of this invention.

A transducer means such as the microphone 22 is mounted within the shell member cavity 14 for converting sound waves or vibrations from the unit operator's voice into corresponding electrical voice signals. The transducer means can comprise any of the various conventional noise cancelling microphones embodying vibratory means which are adapted to respond to sound waves or wave pressures impinging on either of the opposite sides thereof for converting said sound waves or vibrations into said electrical signals. For example, the transducer means can comprise a noise-cancelling carbon-button type of microphone such as is diagrammatically indicated in FIG. 2. As is well known, such a microphone can comprise an electrically-insulating casing 24 which is attached to the peripheral margins of a pair of electro-conductive diaphragms or membranes 26 and 28 for supporting the diaphgrams at opposite sides of the casing, the diaphragms being secured together by a connector 30 so that they are adapted to vibrate as a single unit in response to sound wave pressures impinging upon either diaphragm. A rigid metallic backing member 32 is fixedly mounted within the casing between the unit diaphragms, and the spaces between the diaphragms and the backing member are filled with a multiplicity of carbon granules 34. The backing member is apertured as at 32.1 to permit extension of the connector 30 therethrough, and the backing member and the diaphragm 28 are connected in an electrical circuit as indicated by the leads 36 and 38 for directing an electrical current through the carbon granules 34 therebetween. Since noise-cancelling microphones of this type are well known, the transducer 22 will not be further described herein but it will be understood that vibrations of the diaphragms 26 and 28 in response to sound wave pressures will be adapted to modulate the electrical current directed through the carbon granules for providing electrical signals corresponding to said sound wave pressures. It should also be understood that any other conventional transducer means which are adapted to respond to sound wave pressures impinging upon either of two opposite sides thereof could be employed in the shell member 12 within the scope of this invention.

The microphone means 22 is preferably mounted within the shell member cavity 14 in a generally conventional manner, as illustrated in FIGS. 1 and 2, so that one of said opposite sides of the microphone means is adapted to face the unit operator's mouth, whereby the diaphragm 28 for example can vibrate in response to sound vibrations from the operator's voice as indicated by the arrow 37. The microphone need not be positioned in the precise position illustrated but should be located so that sound wave pressures from the operator's voice can impinge primarily upon one microphone diaphragm such as the diaphragm 28. Preferably, also, the microphone means should be mounted within the cavity 14 to permit the free movement of air around the periphery of the microphone between said opposite sides of the microphone as indicated in FIG. 1 by the arrow 39. For example, as shown in FIG. 1, a single bracket 40 can be secured to the shell member 12 and to a microphone casing flange 24.1 in any conventional manner for supporting the microphone means near the center of the shell member cavity.

The leads 36 and 38 from the microphone 22 can extend through an aperture 12.2 in the shell member and the aperture can be sealed in air-tight relation with an epoxy resin 42 or the like in a conventional manner. Preferably the leads are provided with plug-type or other suitable terminals 36.1 and 38.1 exteriorly of the shell member to adapt the microphone unit 10 for convenient connection in an electrical communications circuit in well known manner.

According to this invention, conduit means such as a pair of tubes 44 and 46 are incorporated in the unit 10, the tubes being formed of any suitable plastic or metal material or the like. The tubes are adapted to extend through an aperture 12.3 in the shell member 12 to form air passages 48 and 50 leading from outside the shell member cavity to respective opposite sides of the transducer means 22, the shell member aperture being otherwise sealed in air-tight relation with an epoxy resin or other potting material 52. The tubes 44 and 46 are preferably cut off substantially flush with the outside of the shell member 12 and extend through the shell member aperture 12.3 in side-by-side relation so that it can be said that the air passages formed by the tubes lead from substantially the same location exteriorly of the shell member. The tubes should be substantially equal in size to form air passages 48 and 50 of substantially equal cross-section, and preferably the air passages formed by the tubes can be of substantially equal length. For example, the tubes can have an inside diameter on the order of ⅛ inch and can be positioned in the aperture 12.3 with about 1/16 inch spacing therebetween. Further, the tubes can be supported within the shell member cavity by brackets 54 and 56 mounted upon the microphone casing flange 24.1, and these brackets should be adapted to hold the terminal ends of the tubes 44.1 and 46.1 in substantially identical positions relative to the respective microphone diaphragms 26 and 28. Further, the terminal ends of the tubes 44 and 46 within the cavity 14 are preferably open to fluid pressures within the cavity to a substantially equal extent. Thus, as shown in FIGS. 1 and 2, the terminal ends of the tubes can be held in equally spaced relation to the respective diaphragms 26 and 28 near the centers of the diaphragms and the axes of the tubes adjacent the terminal ends of the tubes can be substantially aligned.

In this construction, the microphone unit operator can hold the unit 10 in air-tight sealed relation to his face and can speak directly into the shell member cavity 14. The sound wave pressures or vibrations from the operator's voice will impinge directly upon the microphone diaphragm 28 for converting said sound wave pressures into corresponding electrical voice signals. The shell member cavity 14 will be well vented by the air passages 48 and 50 so that, as the unit operator inhales and exhales in speaking into the microphone unit, air can flow into and out of the cavity 14, whereby fluid pressure within the unit cavity 14 can remain at comfortable levels over long periods of time. Since the microphone means 22 is substantially enclosed within the sound-absorbing shell member 12, the microphone means will be substantially shielded from the effects of ambient noise even under high intensity noise conditions in the operator's general environment. However, those ambient noise vibrations or wave pressures which will be transmitted through the air passages 48 and 50 will enter the air passages from substantially the same location outside the shell member 12 and will therefore be of substantially equal amplitude and will be substantially in phase as indicated in FIG. 2 by the single arrow 58. Since the air passages 48 and 50 are of substantially equal cross-sectional area and length and terminate in substantially identical positions relative to the connected microphone diaphragms 26 and 28, the ambient noise waves or wave pressures transmitted through said air passages will impinge upon the respective diaphragms with substantially equal amplitude and substantially in phase and will therefore tend to cancel their effects upon the diaphragms so that the diaphragms will not tend to vibrate in response to said noise wave pressures. See the arrows 60 and 62 in FIG. 2. Further, since the terminal ends of the tubes forming the air passages 48 and 50 are each open to fluctuations of fluid pressure within the shell member cavity 14, fluctuations of fluid pressure within the cavity will cause air to flow within both passages 48 and 50 to somewhat equal extents, whereby the cavity will be well vented and whereby the use of the passages as vents for the cavity will not tend to disturb the phase and amplitude balance of ambient sound wave pressures transmitted through the passages.

It can be seen therefore that the microphone unit 10 provided by this invention can be freely vented to permit convenient and comfortable use of the unit by an operator over long periods of time. It can also be seen that the transducer means embodied in the unit can be substantially shielded from the adverse effects of ambient noise but that ambient noise wave pressures which do impinge upon said transducer means can be cancelled to substantially prevent conversion of said noise wave pressure into electrical signals. Thus the mouthpiece microphone unit provided by this invention can achieve better signal-to-noise ratios than have previously been possible with microphone means known in the art and can provide satisfactory transmission of voice-communications under certain extremely high intensity noise conditions where voice communications had previously been impossible.

It should be noted that the terminal ends of the tubes 44 and 46 have been described above with reference to FIGS. 1 and 2 such that the tube axes adjacent the terminal ends are substantially aligned. However, the tubes could be supported so that said tube axes are arranged in parallel relation to the diaphragms 26 and 28, as shown at *44a* and *44b* in FIG. 3. The tube ends could also be mounted in any other similar manner providing that the tube ends are disposed in substantially the same positional relation adjacent the respective diaphragms. It should also be understood that, although particular embodiments of this invention have been described for the purpose of illustrating this invention, this invention includes all modifications or equivalents of the described embodiments which fall within the scope of the appended claims.

Having described my invention, I claim:

1. A mouthpiece microphone unit comprising a sound-shielding shell means which forms a cavity having an open end and which has a rim around said open cavity end adapted to fit in sealed relation around the mouth of an operator, transducer means mounted within the shell cavity for converting sound wave pressures from the

operator's voice into corresponding electrical voice signals, said transducer means including means adapted to vibrate in response to sound wave pressures impinging on either of two opposite sides thereof in converting said wave pressures to said electrical signals, and conduit means forming air vent passages of substantially equal cross-sectional size which extend through the shell means from outside the shell means and which terminate at opposite sides of said vibratory means within the shell cavity in equally spaced relation to said vibratory means so that ambient noise wave pressures transmitted through said air passages can impinge upon said opposite sides of said vibratory means substantially in phase.

2. A mouthpiece microphone unit comprising a sound-shielding shell means which forms a cavity having an open end and which has a rim around said open cavity end adapted to fit in sealed relation around the mouth of an operator, transducer means mounted within the shell cavity for converting sound wave pressures from the operator's voice into corresponding electrical signals, said transducer means including means adapted to vibrate in response to sound wave pressures impinging on either of two opposite sides thereof in converting said wave pressures to said electrical signals, and conduit means forming two separate air vent passages which extend through the shell means from outside the shell means and which terminate adjacent respective opposite sides of said vibratory means within the shell cavity, said conduit means forming said separate air vent passages in balanced relation to each other so that ambient noise wave pressures transmitted through said air passages can impinge upon said opposite sides of said vibratory means with substantially equal amplitude and substantially in phase.

3. A mouthpiece microphone unit comprising a sound-shielding shell means which forms a cavity having an open end and which has a rim around said open cavity end adapted to fit in sealed relation to the face around the mouth of an operator, microphone means mounted within the shell cavity for converting sound wave pressures from the operator's voice into corresponding electrical voice signals, said microphone means including diaphragm means which are adapted to vibrate in response to sound wave pressures impinging upon either of two opposite sides thereof in converting said wave pressures into said electrical signals, and conduit means forming a pair of air vent passages of substantially equal cross-sectional size which extend from substantially the same location outside the shell cavity and which terminate within the cavity at respective opposite sides of said diaphragm means in equally spaced relation to the diaphragm means so that ambient noise wave pressures transmitted through said air passages can impinge upon said opposite sides of the diaphragm with substantially equal amplitude and substantially in phase.

4. A mouthpiece microphone unit comprising a sound-shielding shell means which forms a cavity having an open end and which has a rim around said open cavity end adapted to fit in sealed relation to the face around the mouth of an operator, microphone means mounted within the shell cavity for converting sound wave pressures from the operator's voice into corresponding electrical voice signals, said microphone means including diaphragm means which are adapted to vibrate in response to sound wave pressures impinging upon either of two opposite sides thereof in converting said wave pressures into said electrical signals, and conduit means forming a pair of air vent passages of substantially equal length and cross-sectional size which extend from substantially the same location outside the shell means and which terminate within the shell cavity at respective opposite sides of said diaphragm means in equally spaced relation to the diaphragm means, said air passages each being open to fluid pressures within the shell cavity so that ambient noise wave pressures transmitted through said air passages can impinge upon said opposite sides of the diaphragm means with substantially equal amplitude and substantially in phase.

5. A mouthpiece microphone unit comprising a cup-shaped shell which forms a cavity having an open end and which has a rim around said open cavity end adapted to fit around the mouth of an operator, sound-absorbing means lining the shell cavity, yieldable means attached to the shell for sealing the rim thereof in air-tight relation to the operator's face around the operator's mouth, a microphone mounted within the shell cavity for converting sound wave pressures from the operator's voice into corresponding electrical voice signals, said microphone including diaphragm means which are adapted to vibrate in response to sound wave pressures impinging upon either of two opposite sides thereof in converting said wave pressures to said electrical signals, lead means extending in air-tight relation through the shell adapted to connect the microphone in an electrical communications circuit, and a pair of tubular members which extend in air-tight relation through the shell, said tubular members forming air vent passages of substantially equal length and cross-sectional size which extend from substantially the same location outside the shell and which terminate within the shell cavity at respective opposite sides of said diaphragm means in equally spaced relation to the diaphragm means, said air vent passages each being open to fluid pressures within the shell cavity so that ambient noise wave pressures transmitted through said air passages can impinge upon said opposite sides of the diaphragm means with substantially equal amplitude and substantially in phase despite fluctuations of fluid pressure within the shell cavity.

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