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Kaufman et al.

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[54] **AUDIO TRANSMISSION AND RECEPTION ASSEMBLY**

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[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

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[21] Appl. No.: **342,104**

[52] **U.S. Cl.** **325/16**, 325/66, 325/310, 325/361

[51] **Int. Cl.** **H04b 1/38**

[58] **Field of Search** ..... 179/1 UW, 1 ST, 107 E, 179/107 R, 107 G; 325/16, 18, 66, 310, 361, 352; 181/23; 340/5 T, 8 R

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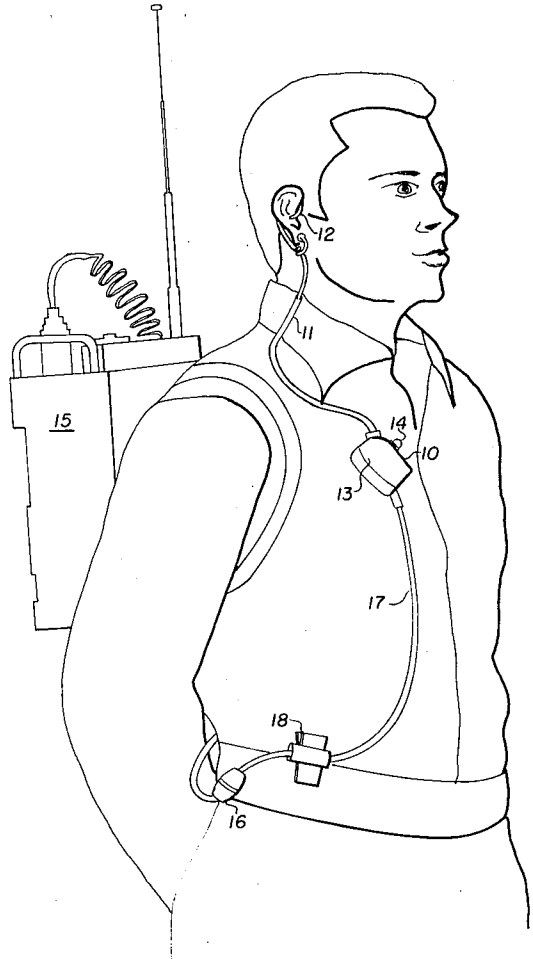
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[57] **ABSTRACT**

An audio transmission reception assembly has a hollow tubular conduit arranged to conduct audio messages from a source within a waterproof enclosure, which may be worn by attachment to the clothing of the user, for conduction to the entrance to the ear canal of the user. The tubular conduit has a capillary portion connected adjacent to the source of the audio messages which renders the conduit virtually waterproof even when subjected to underwater conditions. An audio responsive means is contained in the waterproof enclosure and sealed from the outside environment by a protective resilient membrane, and a suitable switch supported on the waterproof enclosure provides means for controllably connecting both the audio responsive means and the source of audio messages to a transmitting and receiving radio such as may be carried on the back of the user.

4 Claims, 8 Drawing Figures



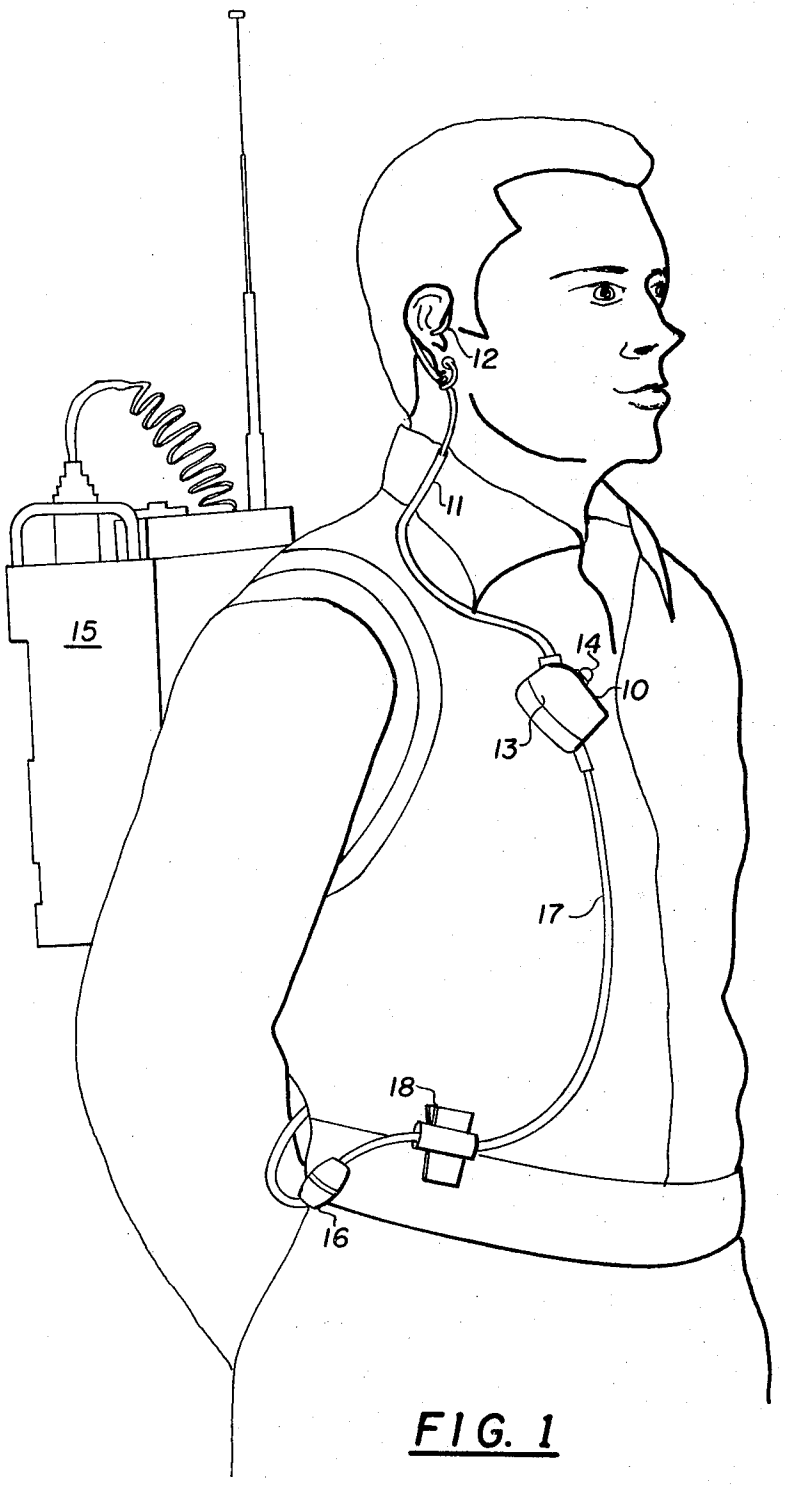
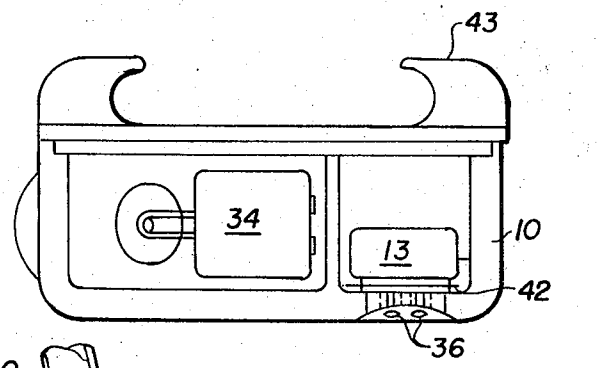


FIG. 1

FIG. 3b



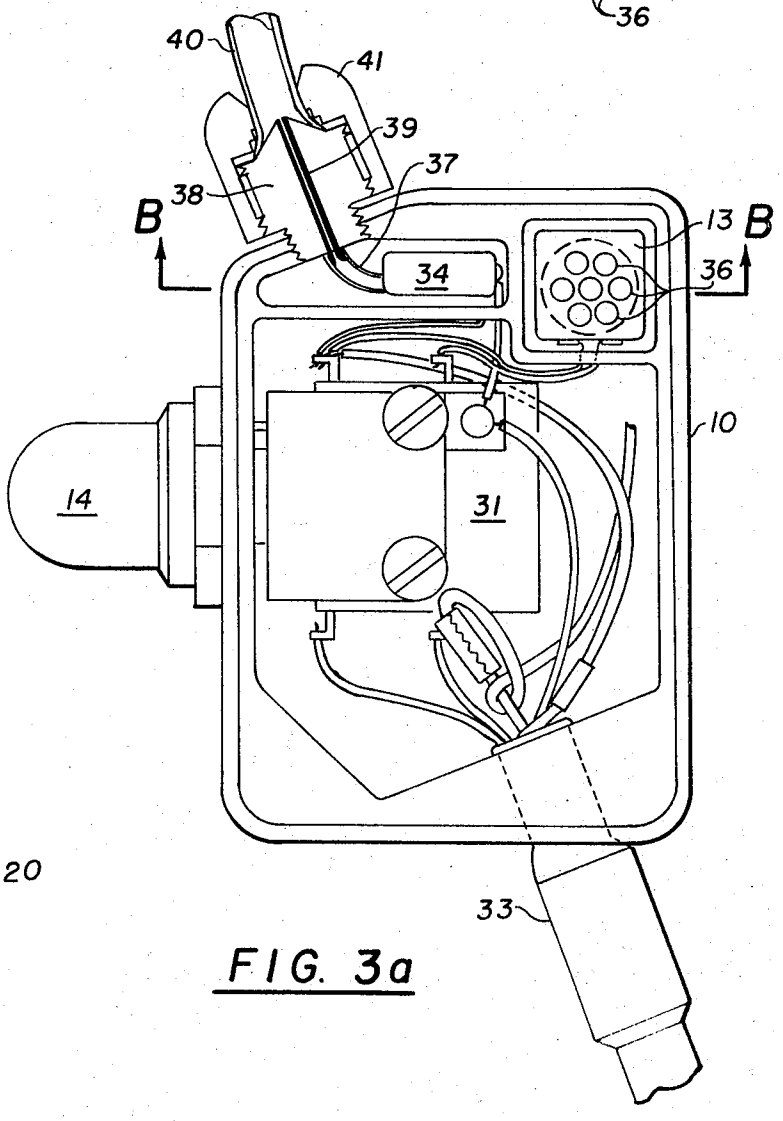


FIG. 3a

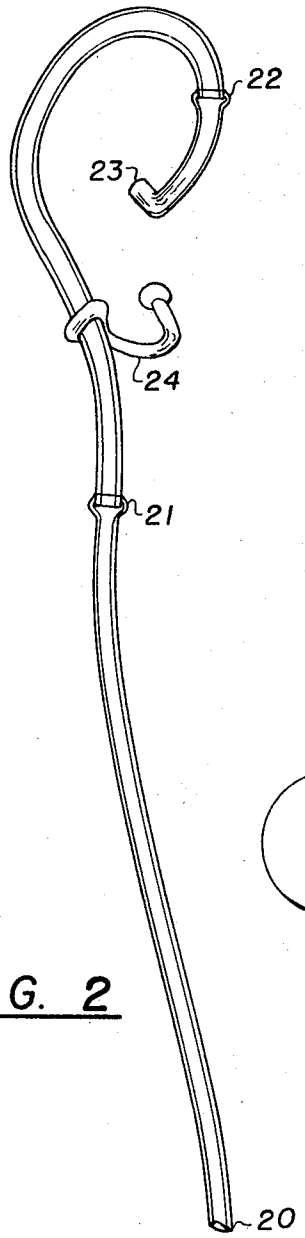


FIG. 2

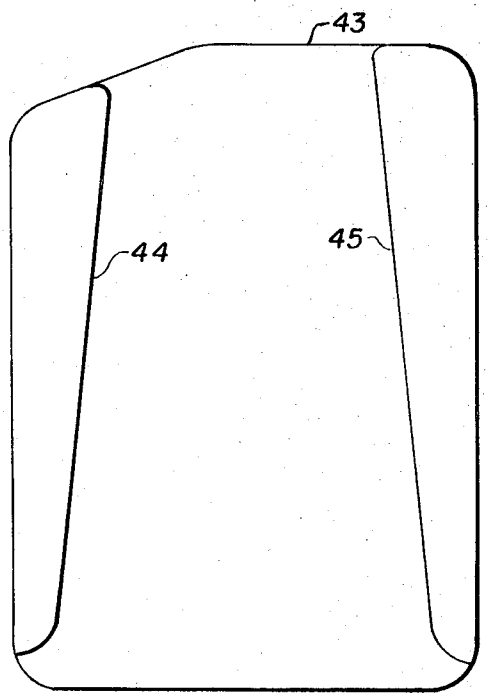


FIG. 4a

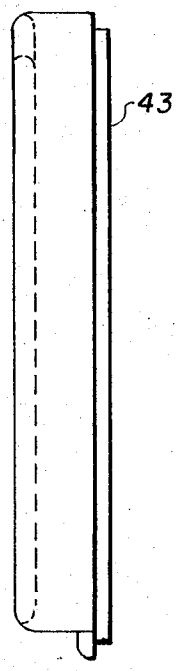


FIG. 4b

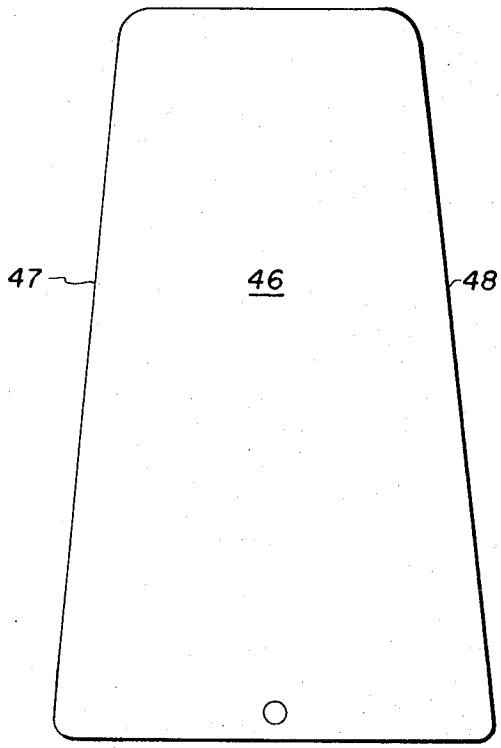


FIG. 5a

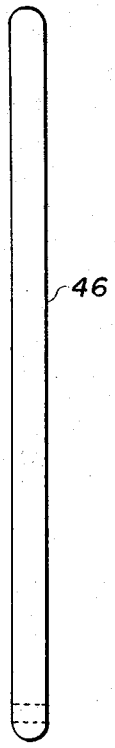


FIG. 5b

AUDIO TRANSMISSION AND RECEPTION ASSEMBLY

BACKGROUND OF THE INVENTION

In tactical military situations it is highly desirable that radio communications be carried on with the highest degree possible of convenience to the radioman or other user of radio equipment. A prime requisite is that such equipment be conveniently and comfortably portable by the user. It is also desirable that the messages delivered be as highly intelligible as possible and also be virtually non-radiating; that is to say, that only the radioman or user be able to hear incoming messages. Another requisite is that the audio reception and transmission assemblies employed in such radio communications be aurally non-occluding for unimpaired hearing and sense of directionality.

It is also preferable that such radio communications equipment, and more particularly the audio reception and transmission assemblies used with them, be capable of being continuously used during sleep and maneuvers without discomfort or detachment from the user.

A further requisite is that the audio reception and transmission assembly employed with such radio equipments be capable of quick disconnection from the radio cables to prevent damage to attaching cables such as may result from excess stress due to sudden, violent moments of the user during tactical field use. Another requirement of the audio reception and transmission assembly is that it be inconspicuous, even under conditions where the user wears no helmet or hat.

An overall consideration is that the cost of the audio reception and transmission assembly compare favorably with present functionally equivalent means and be suitable for adaptation to electrical interface with existing portable radio equipments.

Present state of the art audio reception and transmission assemblies include hand-held, walk-talk radio units, hand-held receiving and transmitting transducers, as well as transducers which depend upon physical contact with the user, such as throat microphones or bone conduction transducers. Though these state of the art devices possess some desirable characteristics, none has as yet been devised to meet all the requisites as hereinbefore enumerated. Therefore, it is highly desirable that an audio reception and transmission assembly be devised which will meet all the foregoing requirements.

SUMMARY OF THE INVENTION

The present invention comprises an audio transmission and reception assembly which includes a source of radio messages contained within a waterproof enclosure and a hollow tubular conduit arranged to receive the emanating audio messages for conduction to the entrance of the ear canal of the user, the conduit having a capillary portion connected adjacent to the source of audio messages. The capillary portion of the hollow tubular conduit renders the conduit virtually impervious to the passage of water even when the entire assembly is subjected to underwater conditions.

Audio responsive means is contained within the waterproof enclosure and sealed from the outside environment by a protective resilient membrane which performs the function of admitting the passage of audio energy, while at the same time sealing the internal audio responsive means against water or other undesirable contaminants.

In a preferred embodiment, the protective, resilient membrane is molded into pliable, shock absorbent material formed to fit around the audio responsive means, thus providing shock proof protection.

A suitable switch means is supported on the waterproof enclosure and used to controllably make connection of the audio responsive means to a transmitting and receiving radio equipment such as may be conveniently and comfortably carried on the back of the user by a suitable backpack or harness arrangement.

In a preferred embodiment of the present invention a breakaway connector is employed for convenient disconnection of multiple electrical conductors connected between the waterproof enclosure and the cables from a back-carried radio equipment, for example. This provides an automatic disconnect which will function to avoid damage to multiple electrical conductors should they be inadvertently subjected to undue mechanical stress.

In a preferred embodiment of the present invention, the hollow tubular conduit which is adapted and arranged to receive audio messages for conduction to the entrance to the ear canal of the user, may comprise multiple sections in addition to the capillary portion connected adjacent to the source of audio messages. A first flexible section may be connected to the capillary portion to accommodate and compensate for normal body movement of the user, when, for example, the waterproof enclosure including the switch means is attached to his clothing such as a blouse or shirt.

The first flexible section, may in turn be connected to a semi-rigid section of the hollow tubular conduit which is formed to fit the pinna of the ear of a user so as to be conveniently and comfortably supportable thereon. A soft, second flexible section may be connected from the semi-rigid section to complete the hollow tubular conduit to the entrance to the ear canal of the user.

Such multiple sections of the hollow tubular conduit of the present invention may comprise clear plastic which renders the assembly inconspicuous, relatively inexpensive, and comfortable for the user.

Additionally, in a preferred embodiment of the present invention a suitable, slidably adjustable means on the hollow conduit may be employed for securing the conduit to the ear of the user. This latter element may also be made of clear plastic material shaped to clip on the lower portion of the ear of a user while being slidably adjustable to accommodate different configurations and sizes as may be required by different users of the assembly.

In a preferred embodiment of the present invention a suitable means is included for supportably attaching the waterprooof enclosure to the clothing of the user, such as a shirt or blouse, for example, and may comprise a hollow wedge portion molded as an integral part of the waterproof enclosure, which hollow wedge portion is employed together with a co-acting wedge-shaped means to provide attachment to the clothing of the user.

Accordingly, it is an important object of the present invention to provide an audio reception and transmission assembly which conducts radio received audio messages to the ear of a user as intelligibly as possible.

Another important object of the present invention is to provide such an audio assembly which is essentially non-radiating in the sense that only the user may hear incoming messages.

A further object of the present invention is to provide such an audio reception and transmission assembly which is aurally non-occluding for unimpaired hearing and sense of directionality to the user.

A further object of the present invention is to provide such an audio assembly which is as inconspicuous as possible.

Yet a further object of the present invention is to provide an audio reception and transmission assembly which is comfortable to the user and is capable of being worn continuously, even during sleep and maneuvers without undue discomfort or requiring detachment by the user.

Another object of the present invention is to provide an audio reception and transmission assembly which is adapted to quickly disconnect from the user and back-packed radio equipment, as well as being adaptable to universal connection with any of a number of different portable radio equipments.

Yet a further object of the present invention is to devise an audio reception and transmission assembly which incorporates the foregoing desired objectives and at the same time compares favorably in cost to functionally equivalent state of the art equipment.

These and other features, objects, and advantages of the present invention will be better appreciated from an understanding of the operative principles of a preferred embodiment as described hereinafter and as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** illustrates a typical embodiment of the present invention as it may be worn and employed by a user;

FIG. **2** illustrates the hollow tubular conduit of the present invention in an enlarged view;

FIG. **3***a* is a cross sectional view of a waterproof enclosure including a switch means as may be employed in the present invention;

FIG. **3***b* is a sectional view through plane B—B of FIG. **3***a* including the slide guide of the back cover member of the waterproof enclosure;

FIGS. **4***a* and **4***b* are front and side views, respectively, of the back cover member of the waterproof enclosure illustrated in FIGS. **3** and **3***a;* and

FIGS. **5***a* and **5***b* are front and side views, respectively, of a wedge configured element which fits into the hollow wedge slider guide of the back cover illustrated in FIG. **4***a*.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** illustrates an embodiment of the present invention as employed by a typical user. A waterproof enclosure **10** includes a source of audio messages in the form of a suitable electro-audio transducer. A hollow tubular conduit **11** is arranged to receive the audio messages from the source within the water-proof enclosure **10** for conduction to the entrance of the ear canal of the user at **12.**

The waterproof enclosure **10** also includes an audio responsive means **13,** usually in the form of a miniature microphone, which is selectively and controllably connectable through the operation of the actuator button of a switch means **14** to a transmitting and receiving radio equipment **15** carried on the back of a user as illustrated in FIG. **1.** A breakaway connector **16** is also preferably provided for quick disconnection of the multiple electrical conductors **17** connected between the waterproof enclosure **10** and the radio **15** to avoid damage to the multiple electrical conductors **17** when they are subjected to a predetermined amount of stress. A clip **18** or equivalent means may also be provided, if desired, for the purpose of restricting movement of the multiple electrical conductors **17.**

FIG. **2** illustrates the major portion of a typical hollow tubular conduit as conceived by the present invention for conducting messages from the audio source within the waterproof enclosure **10** illustrated in FIG. **1** to the entrance of the ear canal of a user. The hollow tubular conduit illustrated in FIG. **2** includes a first flexible section extending from the point **20** to point **21** where it is attached to a semi-rigid section extending from point **21** to point **22.**

The semi-rigid section of the hollow tubular conduit is formed to fit the pinna of the ear of a user so that it is configured to loop over the ear and be supported thereby. A second soft flexible section extends from the end of the semi-rigid section at point **22** to point **23** and is preformed in a substantially right angular configuration, turning into the plane of the drawing of FIG. **2,** so as to fit into the entrance of the ear canal of a user as illustrated in FIG. **1.**

A suitable means **24** is shaped and configured for supportably securing the hollow conduit to the ear of a user. Preferably, the securing element **24** is slidably adjustable having a friction fit to the outside of the hollow tubular conduit. In a preferred embodiment of the present invention the entire extent of the hollow tubular conduit illustrated in FIG. **2** may be fabricated of a clear plastic so as to be as inconspicuous as possible and at the same time relatively inexpensive to fabricate.

FIG. **3***a* is a cross-sectional view of the preferred form of the waterproof enclosure **10** illustrated in FIG. **1.** The waterproof enclosure comprises a body member **10** which contains a switch **31** having an external actuator **14.** The switch is connected to multiple electrical conductors contained within the cable **33** connecting to the back-supported transmitting and receiving radio equipment. Also connected to the switch **31** is a source of audio messages in the form of an electro-audio transducer **34.**

Additionally, a microphone, usually of subminiature form, or an equivalent transducer **13** is connected in circuit with the switch **31.** The body member **10** includes a plurality of holes **36** therein for the purpose of admitting audio energy to the microphone **13.** The tube **37** connects the transducer **34** with a tube adapter **38.** The tube adapter **38** forms part of the hollow tubular conduit connecting the source of audio messages **34** with the entrance to the ear canal of the user and it should be noted that it comprises a capillary section **39.**

This capillary section may be a small bore of the dimension of the order of twenty-five thousandths of an inch in diameter or less and provides an important feature of the present invention which renders the hollow tubular conduit virtually impervious to submersion in water, preventing water from reaching the interior of the waterproof enclosure **10.** However, it has been found that the capillary section **39** is capable of good

transmission of audio frequencies and adequate fidelity for full understanding of voice communications when connected to a radio under normal operating conditions.

The tube adapter **38** is connected to the end **40** of the flexible section of the hollow tubular conduit as illustrated in FIG. **2** which is held in place by a suitable threaded ferrule **41.**

FIG. **3***b* is a cross-sectional view taken through section B-B of FIG. **3***a* and illustrates the electro-audio transducer **34** which is the source of audio messages as well as the audio responsive means **13,** usually in the form of a miniature microphone. It should be noted that the audio responsive means **13** which is enclosed within the body member **10** of the waterproof enclosure is sealed from the outside environment by a protective resilient membrane **42** which operates to transmit audio energy as received through the multiple holes **36** but prevents moisture, water or other contaminants from entering the interior of the body member **10** of the waterproof enclosure.

FIG. **3***b* also illustrates a preferred type of back cover **43** which is suitably attached and sealed to the body member **10** of the waterproof enclosure. It should be noted from the illustration of FIG. **3***a* that the back cover **43** is configured substantially in a hollow wedge shape at its sides. This particular aspect of the configuration of a preferred form of back cover **43** is more fully illustrated in FIGS. **4***a* and **4***b*.

FIG. **4***a* illustrates an end view of the same back cover **43** shown in cross-sectional view as part of the waterproof enclosure illustrated in FIG. **3***b*. It will be noted that the sides **44** and **45** of the back cover **43,** extend upwardly from it as may be seen from FIG. **3***b* and also slope toward each other to form a hollow wedge configuration. This configuration of the sides **44** and **45** coacts in use with a wedge element **46** illustrated in front and side views in FIGS. **5***a* and **5***b*, respectively. The wedge member **46** has sloping sides **47** and **48** which are shaped and dimensioned to fit within the hollow wedge shaped edges **44** and **45** of the back cover **43** in compressive frictional engagement.

In use the back cover **43** of the waterproof enclosure **10** is placed against the clothing of the user while the wedge **46** is inserted from the opposite side of the clothing so as to frictionally engage the material of the clothing between the wedge **46** and the hollow wedge shaped sides **44** and **45** of the back cover member **43,** thus supporting the waterproof enclosure **10** conveniently on the clothing of the user and at the same time being readily removable without damage to such clothing.

USE AND OPERATION

In use the present invention is first connected to a transmitting and receiving radio **15** as illustrated in FIG. **1** by means of the breakaway connector **16** which completes electrically conductive paths from the multiple conductors **17** to the radio equipment **15.** The clip **18** may then be attached to the belt or other suitable portion of the user's clothing or equipment, and the waterproof enclosure **10** is attached or secured to an appropriate part of the user's clothing as previously described in connection with the disclosure of the function of the back cover **43** as illustrated in FIGS. **4***a*, **4***b*, and FIGS. **5***a* and **5***b*.

The semi-rigid portion of the hollow tubular conduit **11** is then fitted about the ear of the user, the soft flexible portion **12** being inserted at the entrance of the ear canal of the user, as illustrated in FIG. **1.** The securing means **24,** as illustrated in FIG. **2,** which is slidably adjustable on the semi-rigid portion of the hollow tubular conduit is slidably adjusted so as to supportably secure the hollow tubular conduit in its desired placement relative to the ear of the user. The user then will receive all audio messages from the source of incoming audio messages which may take the form of a suitable electroaudio transducer as indicated at **34** in the illustration of FIG. **3.**

When the user desires to transmit a message, he depresses the actuator portion of the switch **14,** as illustrated in FIG. **1,** which connects the subminiature microphone or equivalent transducer **13** to the back-carried radio equipment **15.** His speech is then transmitted through the multiple conductors **17** and the breakaway connector **16** to the radio equipment **15** for radio transmission on the air. When the actuator of the switch **14** is released, the switch **31,** as illustrated in FIG. **3,** operates to disconnect the microphone **13** from the radio **15.** Thus, in the preferred embodiment of the present invention the electrical connections are preferably arranged so that the radio equipment is always in a condition to receive messages, but is only in a condition to transmit messages upon the actuation of the external actuator of the switch **14.**

Those skilled and knowledgeable in the art will readily appreciate the advantages and high desirability of the capillary portion of the hollow tubular conduit of the present invention which renders the conduit virtually impervious to the penetration of water, but is nonetheless a configuration fully capable of transmitting voice communications with wholly adequate fidelity for easy comprehension.

Additionally, the hollow wedge shaped configuration of the back cover of the waterproof enclosure as conceived by the present invention, when employed together with a suitably dimensioned wedge member, provides a highly desirable method and means of securing the waterproof enclosure to the clothing of the user in any convenient position. Additionally, it renders the waterproof enclosure of the present invention readily removable to have its position changed or to transfer the equipment to another user without damage or any other desirable effects from the clothing of the user.

It will be readily appreciated by those knowledgeable in the pertinent arts that the concept and the embodiment of the present invention with its manifold desirable aspects and advantages overcomes the more serious disadvantages of prior art equipments having comparable functions.

From the foregoing disclosure and description it should be evident that the present invention provides a convenient means of interfacing electrically with existing portable radio equipments, such as the AN/PRC-25 and the AN/PRC-77, for example, and at the same time provides a breakaway disconnect means which may be quickly used to disconnect the audio transmitting and receiving assembly from the radio. Moreover, since the principal portions of the hollow tubular conduit which conducts audio messages to the entrance of the ear canal of the user may be fabricated of colorless, transparent plastic tubing, it is most inconspicuous and thus highly desirable for tactical field use.

The cost of implementation of the present invention is highly favorable as compared with present handsets and similar equipments having equivalent functions. Moreover, as may readily be seen from the illustrations the typical embodiment of the present invention is capable of being used continuously during sleep and/or maneuvers without undue discomfort or requiring detachment from the user. It is also found to be non-radiating in the sense that only the radioman or user hears the incoming messages and has the advantage of being aurally non-occluding for unimpaired hearing and sense of directionality.

These and other advantages as disclosed hereinbefore render the concept, teaching, and preferred embodiment of the present invention most desirable.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An audio transmission and reception assembly comprising:

a cable including multiple electrical conductors;

a breakaway connector at one end of said cable for connecting said multiple electrical conductors to a transmitting and receiving radio;

a waterproof enclosure at the other end of said cable for receiving said multiple electrical conductors;

an electro-audio transducer supported within said waterproof enclosure for converting signals received from said electrical conductors into audio messages;

a hollow tubular conduit connected to conduct said audio messages to the entrance of the ear canal of the user;

said conduit having a capillary portion connected adjacent said electro-audio transducer;

audio responsive means contained within said waterproof enclosure and sealed from the outside environment by a protective resilient membrane for converting audio energy received through said resilient membrane into commensurate electrical signals; and

switch means supported on said waterproof enclosure for selectively connecting the electrical signals developed by said audio responsive means to said transmitting and receiving radio through said multiple electrical connectors.

2. An audio transmission and reception assembly as claimed in claim **1** wherein said hollow tubular conduit includes a first flexible section connected to said capillary portion, a semi-rigid section formed to fit the pinna of the ear of a user, and a soft, second flexible section connecting said semi-rigid section with the entrance to the ear canal of the user.

3. An audio transmission and reception assembly as claimed in claim **1** wherein said waterproof enclosure has a hollow wedge shaped exterior portion to receive a wedge shaped co-acting member for frictionally engaging flexible material therebetween and supportably attaching said waterproof enclosure to a selectable position on the clothing of the user.

4. An audio transmission and reception assembly as claimed in claim **1** and including slidably adjustable means on said conduit for securing said conduit to the ear of a user.

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