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Santori

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[54] **BONE CONDUCTION MICROPHONE ASSEMBLY**

[75] Inventor: **Charles M. Santori,** San Jose, Calif.
[73] Assignee: **Setcom Corporation,** San Jose, Calif.

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[52] **U.S. Cl.** .... **179/107 BC,** 179/156 R
[51] **Int. Cl.** **H04r 25/00**
[58] **Field of Search** .. 179/107 BC, 108, 1 MF, 156, 179/179

[56] **References Cited**

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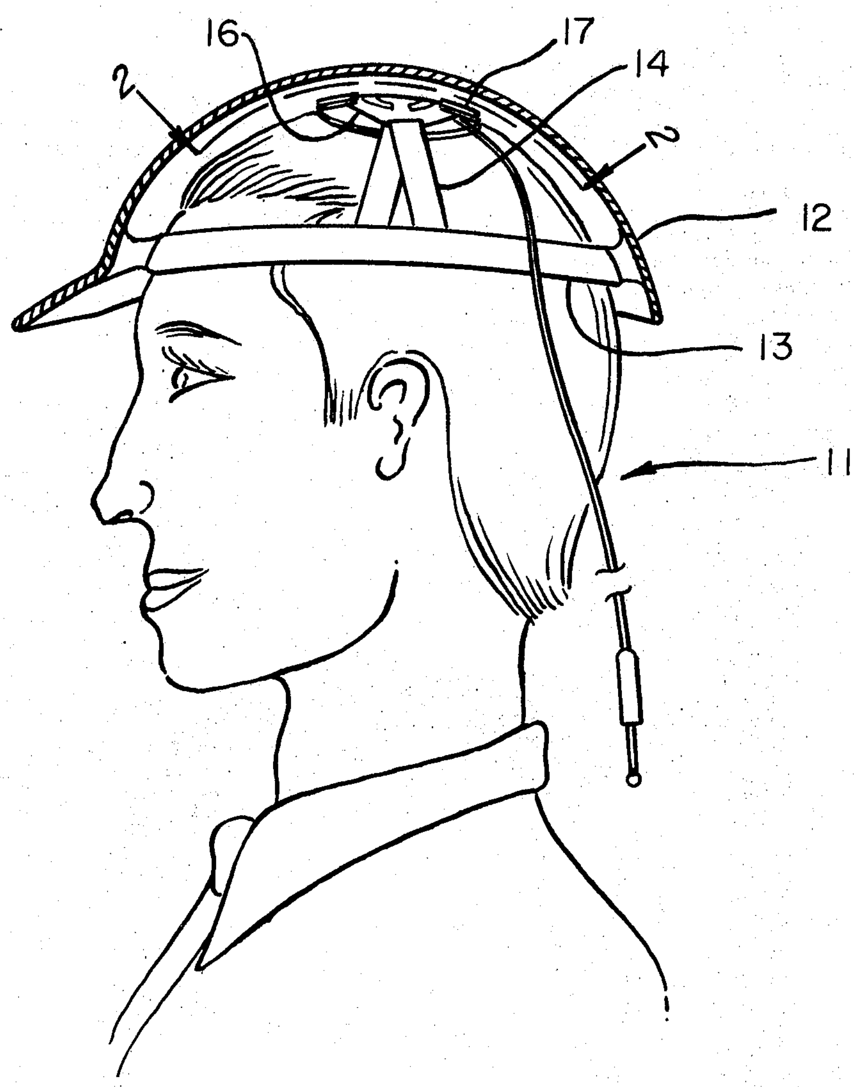
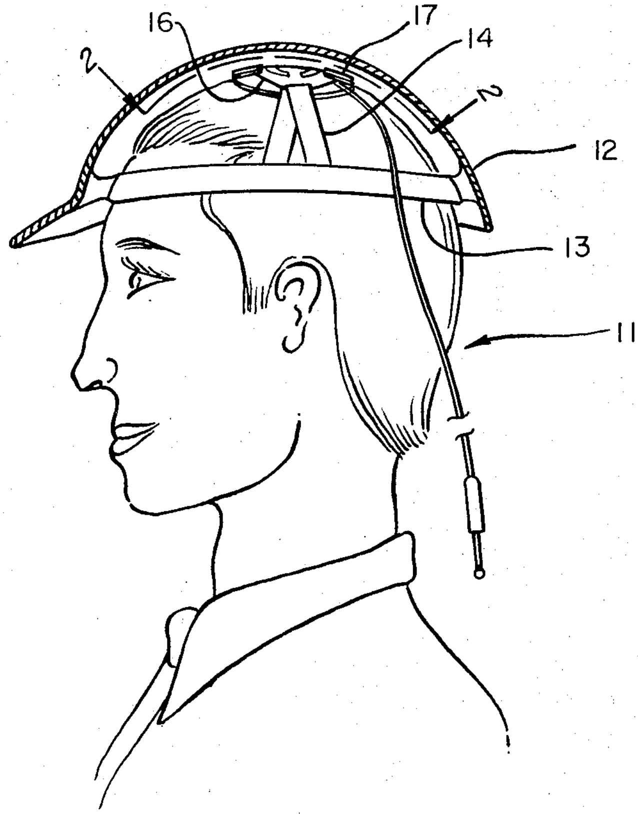
Primary Examiner—Ralph D. Blakeslee
Attorney, Agent, or Firm—Flehr, Hohbach, Test, Albritton & Herbert

[57] **ABSTRACT**

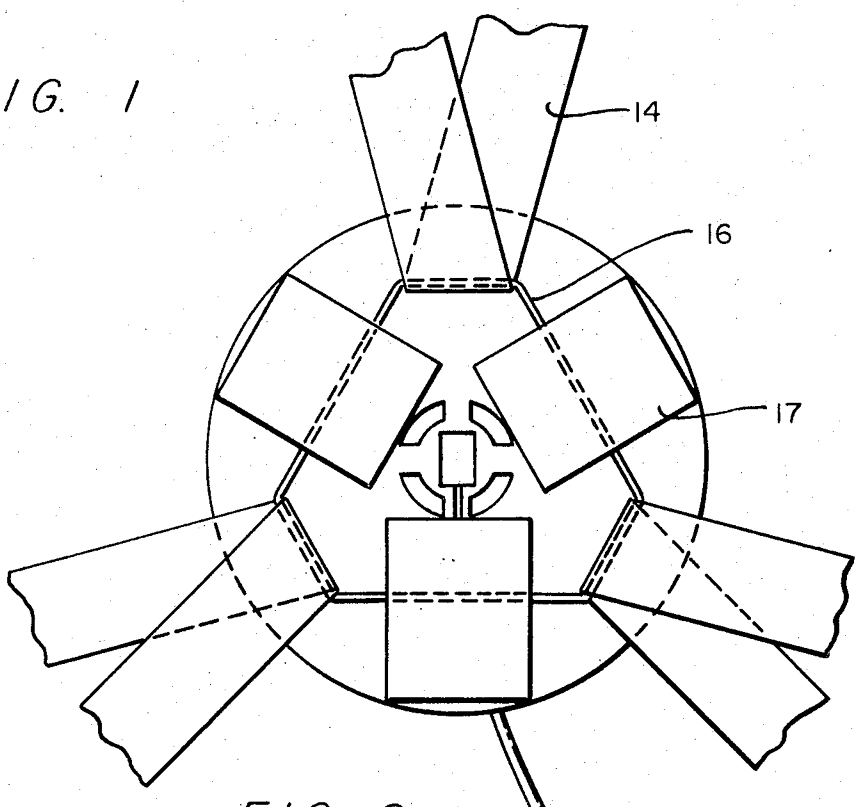
A bone conduction microphone assembly with a transducer mounted in a transducer mount supported from a surrounding support member by spring means which yieldably urges the transducer mount against the user's head with predetermined pressure.

7 Claims, 6 Drawing Figures





F/G. 1



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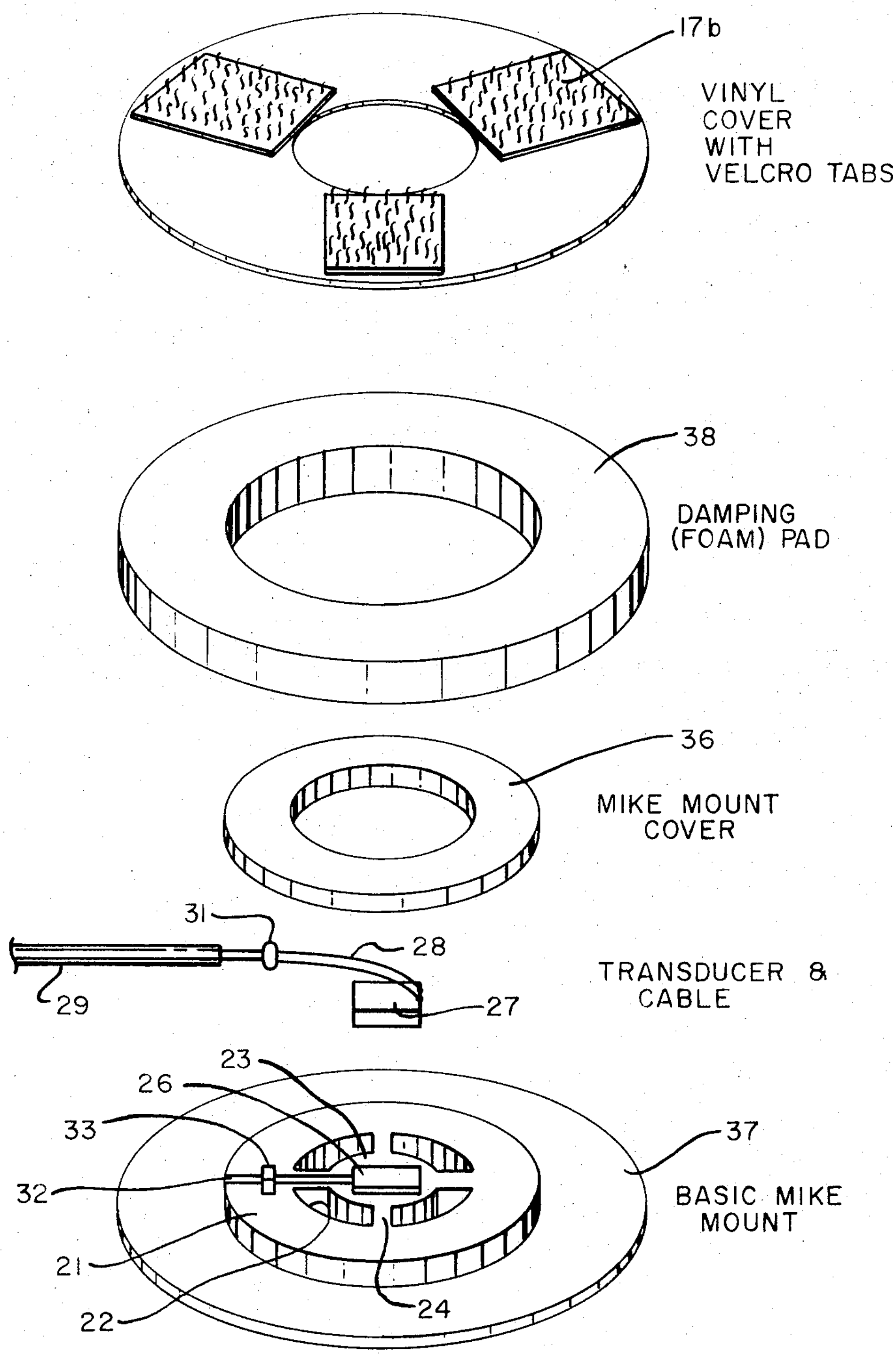
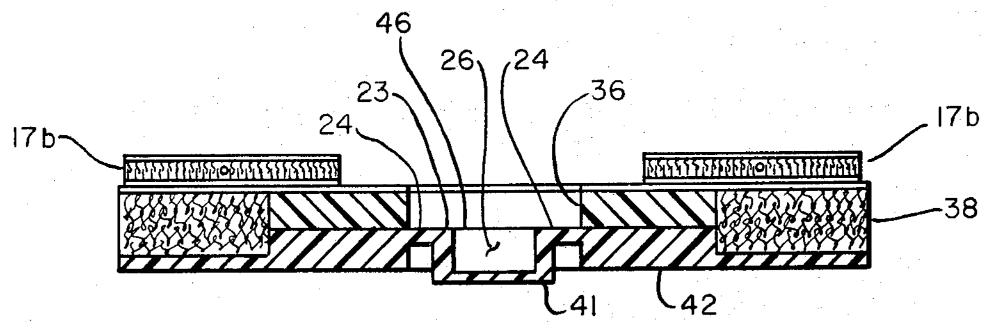
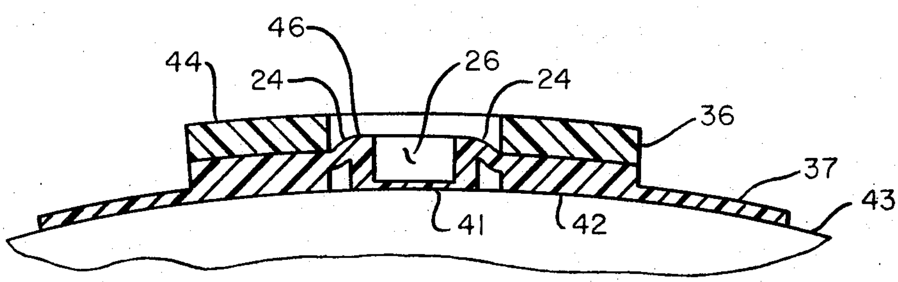

17b
VINYL COVER WITH VELCRO TABS
38
DAMPING (FOAM) PAD
36
MIKE MOUNT COVER
31
28
29
27
TRANSDUCER & CABLE
23
26
33
32
21
22
24
37
BASIC MIKE MOUNT

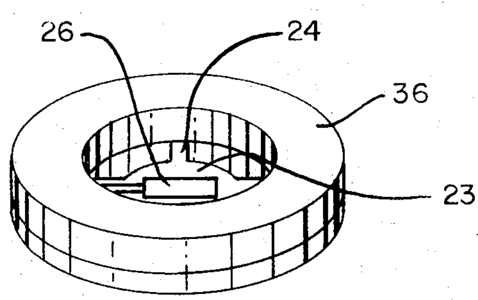
FIG. 3


46
26
24
23
36
24
17b
17b
38
41
42

F/G. 4


46
44
24
26
24
36
37
43
41
42

F/G. 5


26
24
36
23

F/G. 6

BONE CONDUCTION MICROPHONE ASSEMBLY

BACKGROUND OF THE INVENTION

This invention relates generally to a bone conduction microphone assembly and more particularly to a bone conduction microphone assembly suitable for use in a variety of head gear.

Bone conduction microphones operate from energy generated by auditory vibrations of the bones in the head. The microphone transducer is generally a sensitive, low mass accelerometer in intimate contact with the head to pick up the bone vibrations and generate output signals responsive to the auditory vibrations. In many applications the microphone is used by persons who require the use of both hands and in relatively noisy environments. Normally, in such environment the microphone is used in conjunction with some type of head gear such as industrial hard hats, fire, motorcycle, riot and police helmets.

Prior art microphones have serious limitations in such applications. They are adversely affected by ambient noise transmitted through the air or through the head gear from which they are supported. Their size and shape make it difficult and often impossible to mount the transducers in the head gear and so in many instances, when mounted, render the head gear uncomfortable. In some instances, transducers mounted in the head gear are hazardous in that a hard blow to the head gear may drive the transducer into the head and cause injury. The audio quality is, in general, poor because the transducer is not held in intimate contact with the head with sufficient pressure to pick up high frequency vibrations whereby high frequency sound is not effectively reproduced.

OBJECTS AND SUMMARY OF THE INVENTION

It is a general object of the present invention to provide an improved bone conduction microphone assembly which can operate in very high ambient noise conditions.

It is another object of the present invention to provide a bone conduction microphone assembly in which the microphone mount is yieldably pressed against the head with predetermined force to give a satisfactory consistent pressure whereby the microphone operates effectively over a broad frequency spectrum.

It is another object of the present invention to provide a bone conduction microphone assembly with improved protection against possible injury by the transducer under impact forces.

It is still a further object of the present invention to provide a bone conduction microphone assembly which is readily adapted to fit a variety of head gear which can be comfortably worn by the user.

The foregoing and other objects of the invention are achieved by a bone conduction microphone assembly which includes an acceleration sensitive transducer, a transducer mount adapted to receive and hold said transducer, a support structure including a hole for receiving the transducer mount to surround and be spaced therefrom, and spring means cooperating between said transducer mount and said support to yieldably urge the transducer against the head of the user with predetermined pressure when the support rests on the head of the user.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side view partly in section showing the bone conduction microphone assembly in use with a helmet.

FIG. 2 is a view taken along the line 2—2 of FIG. 1 showing the bone conduction microphone assembly held by the helmet suspension straps.

FIG. 3 is an exploded view of the bone conduction microphone assembly shown in FIGS. 1 and 2.

FIG. 4 is a sectional elevational view of the bone conduction microphone assembly.

FIG. 5 shows the bone conduction microphone applied to the head surface.

FIG. 6 is a perspective view of another embodiment of the bone conduction microphone assembly of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The bone conduction microphone assembly of the present invention is particularly suitable for use in head gear such as industrial hard hats, fire, motorcycle, riot and police helmets. Referring to FIG. 1, a user **11** is shown wearing a protective helmet **12**. The helmet includes a headband **13** and suspension straps which hold the helmet on the head of the user with the protective portion of the helmet spaced from the head. The straps **14** extend upwardly from the headband **13** and engage a loop **16**, FIG. 2. The loop **16** is, in turn, sandwiched between Velcro tabs **17** more clearly shown in FIG. 4, **17***a* and **17***b*.

Referring particularly to FIG. 3, the bone conduction microphone assembly includes a transducer support **21** which includes a central hole or opening **22**. A transducer mount **23** is disposed within and spaced from said opening whereby the transducer support **21** surrounds and is spaced from the transducer mount. A plurality of radially extending spring members **24** are adapted to support the transducer mount from the surrounding transducer support. As will be more clearly described, the springs **24** serve to yieldably urge the transducer mount against the head of a wearer to provide intimate contact whereby the transducer mount can effectively pick up the bone vibrations. The transducer and mount are, therefore, isolated from the main support reducing the noise vibrations which can be transmitted through the support.

The transducer mount includes a well **26** adapted to receive and hold the transducer **27**. The mount protects and holds the transducer and yet permits the transducer to respond to minute vibrations of the head bones. The transducer **27** is a sensitive low mass accelerometer as, for example, the type manufactured and sold by Knowles Electronics Inc., its Model No. BL1670. Insulated transducer wires **28** extend outwardly from the transducer and are connected to a cable **29**. A grommet or other suitable stop **31** is provided on the cable **28**. The transducer support member includes a groove or slot **32** adapted to receive the cable with a cross slot **33** adapted to receive the grommet or stop **31** whereby to provide strain relief. The effect of cable vibrations on the transducer is minimized by use of fine transducer wires and by securely attaching the cable to the relatively high mass support member.

The transducer support is provided with a cover **36** which is suitably secured to the top surface of the surrounding support and is adapted to hold the cable in place and to provide a recess or clearance at the top of the transducer mount for purposes to be presently described.

In accordance with the embodiment of the invention shown in FIG. **3**, the transducer support includes an encircling or mounting portion **37** which extends outwardly and has its lower surface coplanar with the lower surface of the transducer support. A damping pad **38** which may, for example, be made of an expanded material, such as Scottfelt, is adapted to surround the support and rest against the upper surface of the mounting member **37.** A vinyl cover with Velcro pads **17*b*** secured at spaced points is suitably affixed to the upper surface of the damping pad and to the upper surface of the microphone cover **36** whereby to provide an assembly of the type more clearly shown in FIG. **4.** As a result, the bone conduction microphone assembly including its supporting ring, cover, microphone mount and spring means is held on the helmet loop **16** by the Velcro tabs **17*a*, 17*b*** and is substantially isolated therefrom by means of the damping afforded by the Velcro tabs and by the damping pad **38.** The microphone assembly is effectively isolated from vibrations of the helmet and helmet straps.

Referring particularly to FIG. **4** showing the assembly, it is noted that the lower surface **41** of the transducer mount **23** extends beyond the lower surface **42** of the transducer support member. The transducer mount **23** is held in this extended position by means of the spring members **24.** The transducer mount, support and spring members may be formed of the same material, for example rubber, in one molding operation. When the transducer support is mounted on the head surface **42** as shown in FIG. **5,** the lower surface **42** of the support rests against the head **43** and the spring members **24** are bent upwardly and provide a yieldable downward force so that the lower surface **41** of the transducer mount rests intimately against the head surface **43** to provide good contact to transfer bone vibrations to the transducer. It has been found that by yieldably urging the transducer mount against the head, good frequency response is obtained.

Referring again to FIG. **4,** it is seen that the upper surface **44** of the transducer support cover is spaced above the upper surface **46** of the transducer mount to provide a recess. Referring to FIG. **5** showing the transducer mounted on the head of a user, it is seen that the upper surface of the transducer mount, even in its mounted condition, is below the upper surface **44** of the cover **36.** In this way, any hard impact to the hat which would otherwise make the helmet itself strike the microphone transducer will strike the large surface **44** distributing the impact forces over a considerable area and preventing injury to the user.

It is apparent that the bone microphone transducer assembly described can be used with other types of supports **37.** Referring to FIG. **6,** another embodiment of the bone conduction microphone assembly is shown. The microphone of this embodiment can be associated with other types of supports.

I claim:

1. A bone conduction microphone assembly comprising an acceleration sensitive transducer, a transducer mount adapted to receive and hold said transducer, a transducer support having an opening larger than said transducer mount for receiving said transducer and mount, said support surrounding and spaced from said transducer mount and a plurality of spring means connected between said transducer mount and said transducer support to hold the transducer in said opening and yieldably urge the transducer against the head of a user with predetermined pressure when the transducer support rests against the head of a user.

2. A bone conduction microphone assembly comprising a transducer mount having upper and lower surfaces, a transducer of the type which provides an output responsive acceleration held in said mount, a support having upper and lower surfaces and an opening larger than said transducer mount for receiving said transducer and mount, said support surrounding and spaced from said transducer mount, spring means extending between said transducer mount and support serving to support said transducer mount in said opening with the lower surface of said transducer mount extending beyond the lower surface of said support whereby when the microphone assembly is placed on a user to pick up bone vibrations the transducer is yieldably urged against the user to move as the associated bones vibrate.

3. A bone conduction microphone assembly as in claim **2** wherein the upper surface of said support is above the upper surface of said transducer mount.

4. A bone conduction microphone as in claim **1** wherein said support, transducer mount and spring means are formed as a unitary molded assembly.

5. A bone conduction microphone assembly as in claim **4** wherein said spring means comprises a plurality of narrow radially extending members.

6. A bone conduction microphone assembly as in claim **1** including a mounting assembly cooperating with said support for mounting said assembly to associated head gear.

7. A bone conduction microphone assembly comprising an acceleration sensitive transducer, a transducer mount adapted to receive and hold said transducer, a support surrounding and spaced from said transducer mount, a plurality of spring means cooperating between said mount and said support to yieldably urge the transducer against the head of a user with predetermined pressure when the support rests on the head of a user, a mounting assembly including spaced mounting members secured to said support for mounting said assembly to associated head gear, and damping means sandwiched between said spaced mounting members.

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