

AD-D001 590

IMMERSIBLE DIVER'S MICROPHONE

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Department of the Navy
Washington, D. C.

27 December 1971

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AD D 001590

Serial Number 212,002

Filing Date 27 December 1971

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NOTICE

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REVERSIBLE DIVER'S MICROPHONE
ABSTRACT OF INVENTION DISCLOSURE

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1 This application discloses an invention including a ceramic
2
3 gradient microphone insensitive to mask cavity acoustics, essentially
4 flat in pressure response to 10,000 Hz for use in deep submergence
5 helium atmospheres, and capable of withstanding compression,
6 decompression and intermittent flooding. In essence, there is
7 provided a microphone having a diaphragm mounted to a bimorph ring
8 and includes unique construction to provide the frequency response
9 and gradient characteristics, plus drainage characteristics.
10

11
12 Deep submergence microphones usable with helium atmospheres
13 are required by divers operating under increased pressure conditions.
14 Using helium, an inert gas, instead of nitrogen, has the advantage
15 that bubbles will not develop in the blood stream of the diver which
16 cause "bends" and other problems associated with dissolved nitrogen
17 in the blood stream. Many microphones have been tried in the
18 environmental conditions of a diving mask. Among those are magnetic
19 microphones which require close clearances between moving parts.
20 When a mask is flooded, sea water penetrates into these spaces,
21 causing corrosion and, in time, an accumulation of salt crystals.
22 Setting the first mechanical element of the diaphragm and piezoelectric
23 ceramic bimorph ring to approximately 20,000Hz provides smooth
24 response in the speech range, extending to 10,000Hz or higher in
25 helium-oxygen atmospheres, without any need for acoustic compensation
26 for the resonance. Such compensation would be altered and degraded
27 by changes in atmospheric pressure and composition. The relatively
28 low sensitivity associated with the 20,000Hz resonance is made up
29 for by solid state amplifier circuitry.

30 With the construction provided by this invention, there are no

1 moving parts requiring close clearances. The protective coverplates
2 are not only perforated but are separated from the housing sufficiently
3 to form 1/10 inch, self-draining slots at their peripheries. The
4 perforations toward the diver's lips may be cleared by blowing. If
5 any water remains temporarily in the perforation on the far side,
6 there is only a minor deterioration of performance.

7 A pressure gradient microphone placed in a diver's helmet close
8 to the lips is insensitive to the acoustics of the diving mask cavity.
9 The diaphragm of a gradient microphone is open to sound on both sides
10 and responds to a pressure difference. The term noise-cancelling
11 microphone is frequently used, as the sensitivity is greater for the
12 approximately spherical waves emerging from the lips than for the
13 more nearly plane waves characteristic of ambient noise.

14 It is an objective of this invention to provide an improved
15 immersible diver's microphone capable of rapid drainage and immune
16 to deterioration of performance due to deposit of salt crystals.

17 It is still a further objective of this invention to provide an
18 improved gradient microphone utilizing spherical diaphragm coupled
19 to a bimorph ring affixed to a housing and mounted in a central cavity
20 therein and having perforated end plates including peripheral slots
21 and a plurality of small circular openings.

22 Therefore, it is an objective of this invention to provide an
23 improved immersible diver's microphone comprising, a housing member
24 having a hollow central portion and having first and second ends,
25 a ceramic bimorph member disposed in the hollow portion, an epoxy
26 affixing the ring within the housing, the ring being substantially
27 normal to the longitudinal axis of the housing, a diaphragm affixed
28 to the ring, first and second end plates affixed to the housing
29 individually having leg members positioning the end plates at
30 distance from the housing member for providing drainage from the

1 central portion, electrical connecting means attached to the bimorph
2 ring and a preamplifier circuit coupled to the electrical connecting
3 means for connecting electrical signals generated by the ring.

4 Yet a further objective of this invention is to provide an
5 improved gradient microphone with protective end plates mounted
6 0.1 inch from the housing to allow for rapid drainage due to flooding.

7 Other objects, advantages and novel features of the invention
8 will become apparent from the following detailed description of the
9 invention when considered in conjunction with the accompanying
10 drawings wherein:

11 Figure 1 is a front view of one embodiment of the invention
12 and

13 Figure 2 is a cross sectional view along lines AA in Figure 1.

14 Figure 1 wherein the immersible microphone is designated
15 generally as 10 has an electrical connection 11 coupled to microphone
16 10. A solid state circuit can be mounted in the expanded part 12
17 or in the housing, part 15, but does not form a part of this invention
18 and is not shown.

19 The microphone itself, consists of a housing member 15 having
20 extending therethru along longitudinal axis 16, a hollow central
21 portion 17. Disposed along the axis 16 is a ceramic bimorph ring 18
22 of a three sandwich layer construction. A kapton diaphragm 20 is
23 affixed to an inner edge of the ring 18 and has electrical connections
24 24 and 23 connected thereto for conducting an electrical signal to an
25 external circuit not shown. Ring 18 is affixed to housing 15 by an
26 epoxy compound 25 that also holds a support ring 26.

27 The support ring 26 has a recessed portion 27 designed to receive
28 legs 28 and 29 of cover plate 30. Housing 15 also has a recessed
29 portion 32 designed to receive support legs 33 and 34 of a second
30 cover plate 35. Each cover plate is affixed to the housing 15 thru

1 screws, two of which 40 and 41 are shown in Figure 1. The cover
2 plate 30 and 35 individually include a plurality of holes designed
3 as 45 for the purpose of allowing the sound waves to reach the
4 microphone's central portion.

5 The cover plates are individually spaced approximately the
6 same distance from the housing to provide for drainage in the event
7 the microphone is flooded.

8 In one successful embodiment of the invention the gradient
9 microphone was tested in atmospheres of 97.5 percent helium at a
10 simulated depth of 650 feet. Listening tests and Sonagrams showed
11 no difference in the helium speech due to any effect of mask cavity
12 as opposed to the open boom mount. Comparisons of Sonagrams for
13 helium speech with those for sea level speech showed a simple
14 proportional upward shift of formant frequencies (resonance frequencies
15 of the vocal tract) of approximately 2.9. There was no indication
16 of the nonlinear shift (first formants more than the second) frequently
17 reported in the literature as a result of the pressures of deep
18 submergence.

19 One of the initial problems overcome by this design was that of
20 helium penetration from extreme depth and potential decomposition from
21 decompression and salt water immersion. In the construction of the
22 microphone the potting compound was degassed in a vacuum before
23 using, and filling operations included several evacuations and
24 recompressions to help avoid trapping any gas.

25 Experiments showed that water would drain readily under its
26 own weight thru a slit less than one tenth of an inch in width,
27 therefore, the protective cover plate for the diaphragm may be
28 separated from the microphone body this tenth of an inch for successful
29 operation. However, coating the inside of the cover plates with a
30 water repellent may permit the slots to be less than one tenth of an

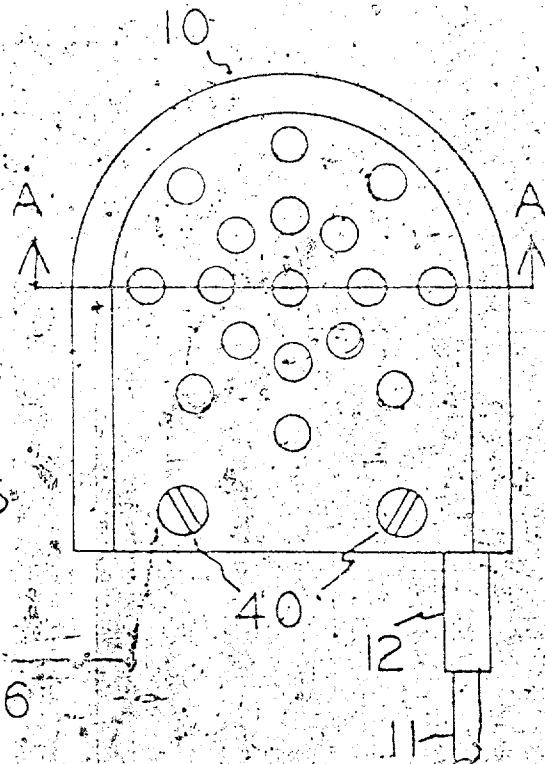
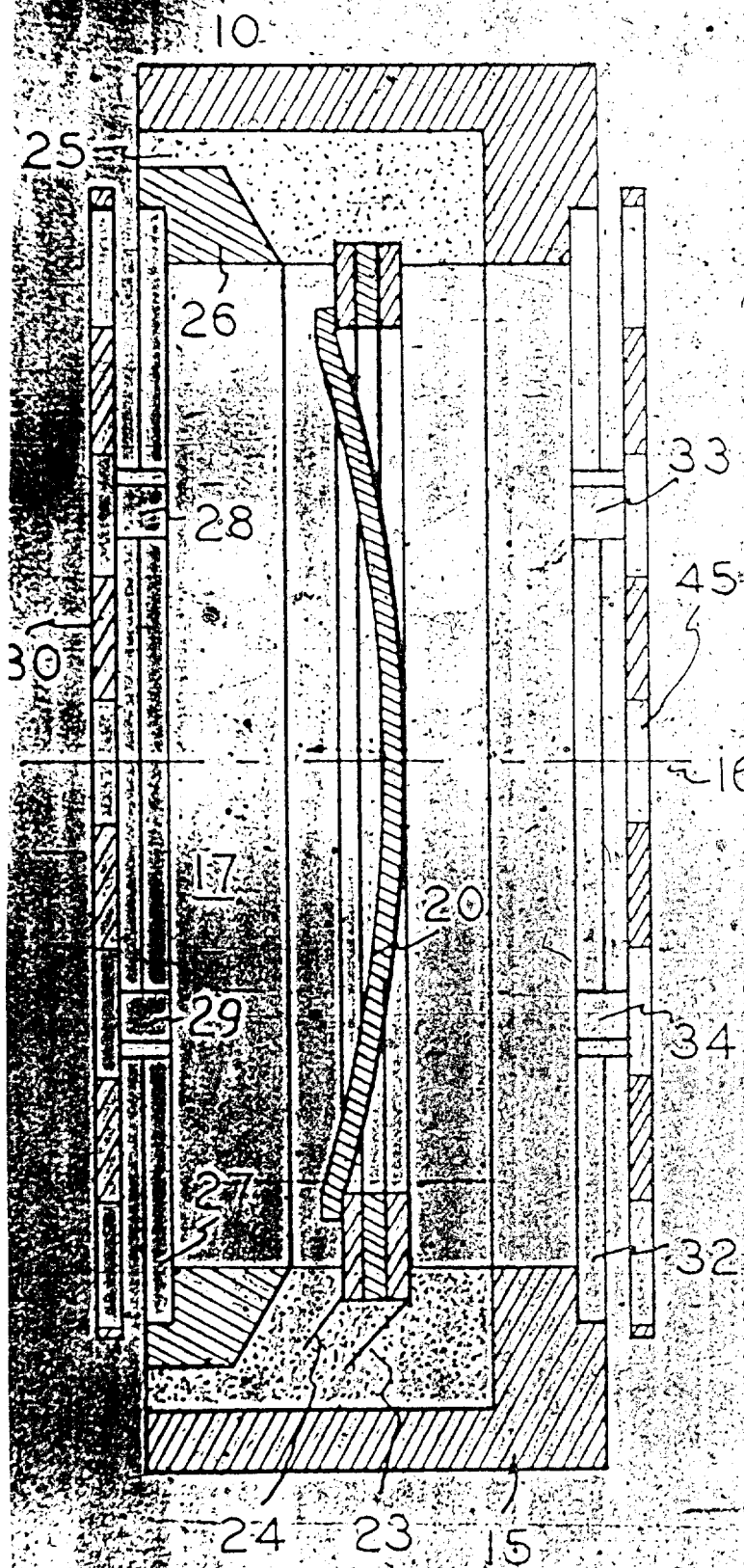
1 inch and still let water drain off without difficulty. The one tenth
2 of an inch is not a critical dimension but is an optimum design parameter.

3 One successful form of epoxy used was Minnesota Mining and
4 Manufacturing Scotch-cast resin No. 8 with a trace of Plastic
5 Molders Supply PMS No. 4640 black dye.

6 Obviously many modifications and variations of the
7 present invention are possible in the light of the above teachings.

8 It is therefore to be understood that [REDACTED]
9 [REDACTED] the invention may be practiced otherwise than as
10 specifically described.

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