

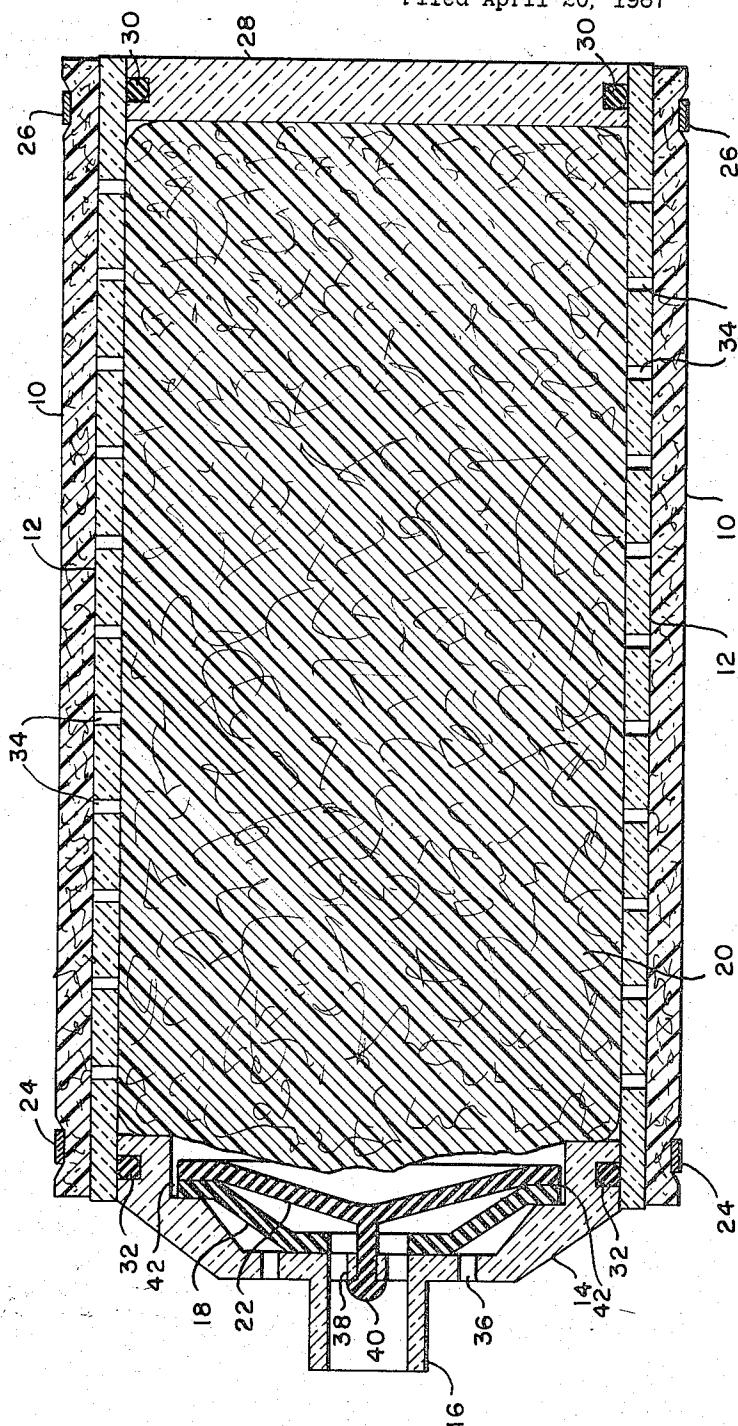
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T. E. KELLY ET AL

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MUFFLER AND DIFFUSER FOR UNDERWATER DIVING

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INVENTORS
THOMAS E. KELLY
FREDERICK BIGGER
BY *Robert F. Rotella* AGENT
W. C. Hodges ATTY.

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MUFFLER AND DIFFUSER FOR UNDERWATER DIVING

Thomas E. Kelly, Victoria, British Columbia, Canada, and Frederick Bigger, Key West, Fla., assignors to the United States of America as represented by the Secretary of the Navy

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ABSTRACT OF THE DISCLOSURE

An underwater sound muffler comprising a container having a check valve for admitting air at one end. The container is apertured and filled with membraneless open cell type foam material. A layer of open cell type foam material having membranes covers the container allowing air to diffuse out without the formation of bubbles.

The present invention relates to sound mufflers and more particularly to a muffler for use in underwater environments in conjunction with self-contained underwater breathing apparatus (SCUBA).

In underwater maneuvers it is important to maintain low noise levels to avoid detection by sound detecting equipment and acoustic influence ordnance. In addition, it is essential to avoid disturbing the environment when observing marine biology. In the past, many attempts have been made to muffle the air exhaust of diving gear using materials such as porous metals and plastics. It was found, however, that such materials were excessively rigid and passed varying amounts of gas thereby causing high breathing resistance and inadequate ventilation for divers.

It is, therefore, the object of this invention to provide an improved exhaust muffler for underwater use which is more effective in reducing noise.

Another object of the present invention is to provide a muffler for use with SCUBA gear which offers minimum breathing resistance.

A further object of this invention is to provide novel underwater breathing apparatus which allows exhaust air to diffuse out thus reducing noise.

These and other objects of the present invention are achieved by providing a novel muffler and diffuser which comprises a container having a check valve for admitting exhaled air at one end thereof. The interior of the container is filled with membraneless open cell type foam material and the exterior of the container is covered with open cell type foam material having membranes. The container is provided with apertures to permit air to communicate between the cellular foam material.

The principles of the present invention will be better understood from the following detailed description taken in conjunction with the drawing in which the sole figure is a sectional view of a preferred form of the muffler and diffuser for underwater diving in accordance with the inventive concepts.

As shown in the figure, one preferred embodiment of the invention shows a container 12 which may be made of fiberglass and may have a generally cylindrical shape. One end of container 12 is sealed by means of a plug 28 and a circumferential gasket 30. The other end of container 12 is fitted with a valve for admitting exhausted air. The valve comprises a valve seat 14 which serves also as a support for the air inlet tube 16. Valve seat 14 is sealed to container 12 by means of an internal circumferential gasket 32. The valve further comprises a first resilient diaphragm 18 having a generally annular shape to conform to the shape of container 12 and being pro-

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vided with a center orifice for allowing the exhaust air to pass therethrough. A second resilient diaphragm 22, which also has a generally annular configuration, is disposed adjacent to diaphragm 18. The center portion of diaphragm 18 is offset from its outer edge thus permitting contact between the two diaphragms at their outer edges only. Diaphragm 22 is provided with a longitudinally extending stem 40 having an enlarged head portion held in position by means of guide 38. Guide 38 may be attached to the valve seat 14 by means of webs, not shown. The valve seat 14 is further provided with a plurality of orifices 36 for communicating between diaphragm 18 and the external water environment.

In operation, water enters orifices 36 and exerts pressure against the diaphragm 18. Exhaust air enters the valve by means of the air inlet tube 16 and flows through the area between diaphragms 18 and 22, driving the outer edges of the diaphragms apart, and then to the interior of container 12 through space 42 formed between the outer edges of diaphragms 18 and 22 and the internal side wall of valve seat 14. The valve operates as a one-way pressure balanced check valve since it permits exhaust air to enter container 12 from inlet tube 16 but prevents water within the container from entering tube 16 since the pressure of the water drives diaphragms 18 and 22 together.

The interior of container 12 is filled with a membraneless open cell type foam material 20. An example of such a suitable material would be membraneless porous polyurethane open cell foam manufactured by Scott Paper Company and sold under the trade name Scottfoam. Container 12 is covered with an external layer 10 of open cell type porous foam material having membranes. An example of suitable material would be open cell polyurethane foam with membranes such as Scott open-pore foam manufactured by Scott Paper Company and described in Design News, Apr. 29, 1964 issue. External clamping bands 24 and 26 secure the foam material layer 10 in place. Preferably, layer 10 is about 1/4 inch thick.

In operation, exhaust air passing through the inlet valve enters the interior portion of container 12 and flows and spreads throughout the membraneless foam material 20. Foam filling 20 prevents water which enters the container 12 through foam layer 10 and orifices 34 from sloshing around thus creating noise. The exhaust air then passes through orifices 34 formed in the wall of container 12 and then to the water environment through foam layer 10. The membrane-containing foam layer 10 allows the exhaust air to pass through only in small round bubbles having greatly reduced sound energy thus further reducing noise production. Furthermore, the foam layer 10 spreads the exhaust air over a wide surface area thereby reducing breathing resistance.

Having described the invention, it will be apparent that many modifications will be obvious to one skilled in the art and, consequently, the scope of the invention is to be measured solely by the following claims.

What is claimed is:

1. A muffler and diffuser for exhaust gases for use with underwater apparatus comprising:

- first diffusing material comprising porous open cell foam of the type lacking membranes;
- second diffusing material comprising porous open cell foam of the type having membranes;
- said first and second diffusing materials being disposed to permit exhaust gas to pass said first and second diffusing materials in sequence;
- said second diffusing material communicating said exhaust gas outside of said apparatus.

2. A muffler and diffuser as set forth in claim 1 wherein:

said foam materials are composed of polyurethane.

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3. A muffler and diffuser as set forth in claim 2 wherein:

said first and second diffusing materials are concentrically oriented.

4. A muffler and diffuser as set forth in claim 3 wherein:

said first diffusing material forms an inner core; and said second diffusing material forms an outer layer surrounding said core.

5. A muffler and diffuser as set forth in claim 4 further comprising:

rigid container means disposed between said first and second diffusing materials.

6. A muffler and diffuser as set forth in claim 5 wherein:

said container means is orificed thereby permitting fluid communication between said first and second diffusing materials.

7. A muffler and diffuser as set forth in claim 6 further comprising:

valve means for admitting gas from said apparatus to said diffusing materials and for preventing water from entering said apparatus.

8. A muffler and diffuser as set forth in claim 7 wherein:

said valve means comprises first and second diaphragms in contact, disposed in axially spaced relationship, pressure from said exhaust gas causing said diaphragms to break contact.

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9. A muffler and diffuser as set forth in claim 8 wherein:

said valve means is disposed in one of said container means;

exhaust gas inlet means for communicating between said valve means and said apparatus; and orifices for permitting communication between said first diaphragm and said underwater medium.

10. A muffler and diffuser as set forth in claim 9 wherein:

said first diaphragm comprises an annular resilient member having an opening through its center;

said second diaphragm comprises an annular resilient member having its center portion fixedly mounted; and

said first and second diaphragms being in contact at the respective outer edges thereof.

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ROBERT S. WARD, JR., *Primary Examiner.*