

[72]	Inventors	John A. Beagles; William H. Armstrong, San Diego, Calif.
[21]	Appl. No.	801,601
[22]	Filed	Feb. 24, 1969
[45]	Patented	June 28, 1971
[73]	Assignee	The United States of America as represented by the Secretary of the Navy

Primary Examiner—Robert S. Ward, Jr.

Attorneys—Justin B. Dunlavey, Ervin F. Johnston and Thomas G. Keough

[54] **DIVING HELMET, INPUT AIR NOISE SILENCER**
3 Claims, 3 Drawing Figs.

[52] **U.S. Cl.**..... **181/36,**
181/56, 181/71

[51] **Int. Cl.**..... **F01n 1/10,**
F01n 7/12

[50] **Field of Search**..... **181/35, 36,**
35.1, 36.1, 36.4, 50, 55, 56, 60, 71, 72, 46

[56] **References Cited**

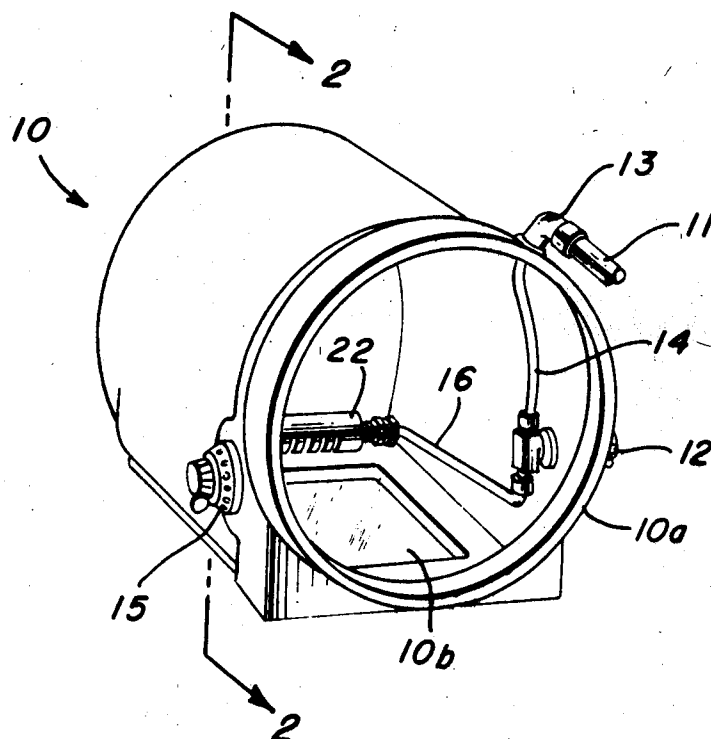
UNITED STATES PATENTS

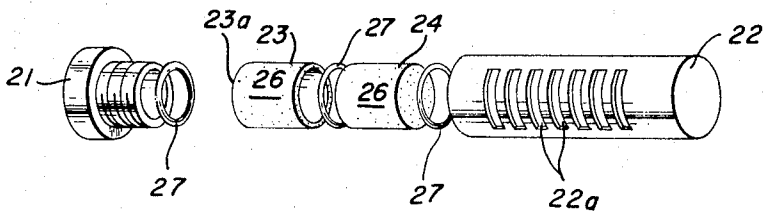
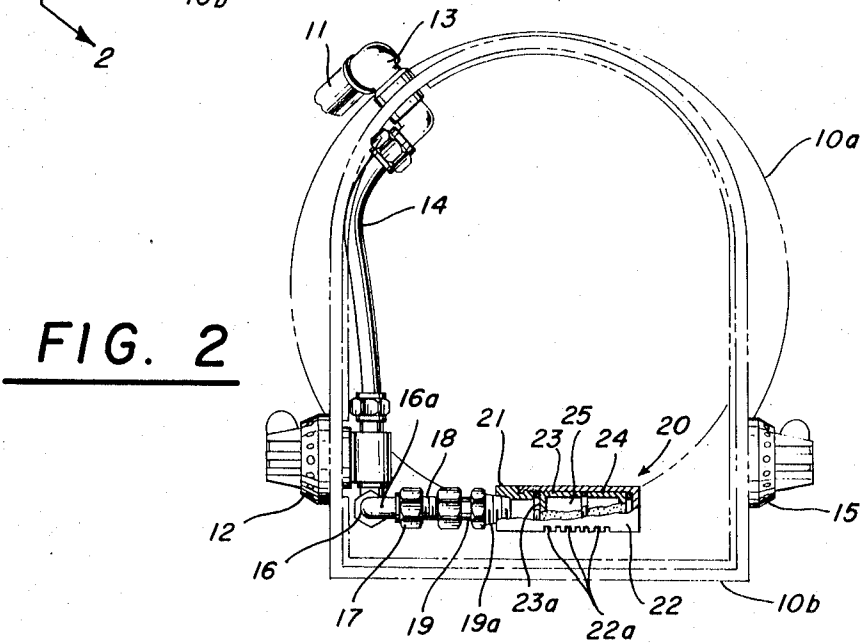
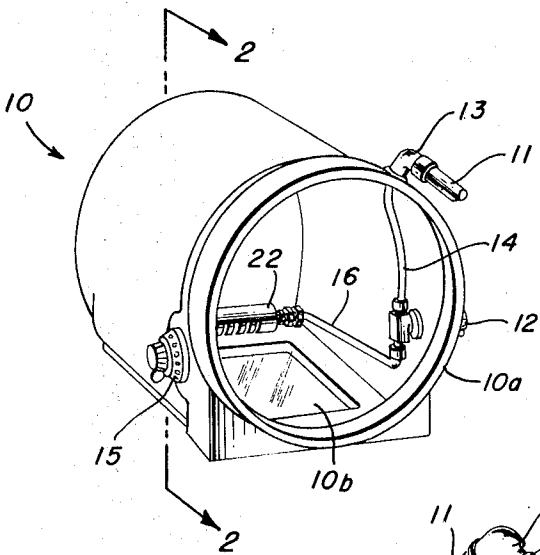
1,128,306	2/1915	Goelzer	181/55
1,935,132	11/1933	Scrimgeour	181/50X
2,485,908	10/1949	Morrow	181/36X
2,577,607	12/1951	Conley	181/36UX
3,112,745	12/1963	Boyer	181/56X
3,137,365	6/1964	Bingel	181/71
3,208,551	9/1965	Carls	181/36(.1)

FOREIGN PATENTS

1,269,772	7/1961	France	181/36(.1)
1,317,700	1/1963	France	181/36(.1)

ABSTRACT: A compact apparatus for reducing gas or air flow noise produced as a gas passes from an external hose to the interior of a diving helmet is provided to minimize the possibility of injury to a diver's hearing and to enable more reliable communications with the surface. The apparatus includes a metallic tube having a plurality of correspondingly oriented parallel slots being attached to a coupler unit joining the apparatus to an external hose. Gas flowing through the hose passes through a first sintered metal wall, into a diffusion chamber, through another sintered metal wall, and out through the slots. The gas flow velocity is thusly reduced and the gas is passed to the interior of the helmet without the noise usually attendant such a transfer. The slotted tube is oriented to direct the gas flow angularly onto a faceplate to prevent the possibility of a diver's fogging the faceplate and further serves to keep the gas flow from directly impinging on an internal wall of the helmet to prevent air flow noise at this point. The dispersion of air flow through the sintered metal filter wall taken with the mixing action in the diffusion chamber and the orientation of the parallel slots ensures gas flow noise reduction using an apparatus only slightly larger in diameter than a short length of air hose.





INVENTORS
JOHN A. BEAGLES
WILLIAM H. ARMSTRONG
BY
Thomas G. Keough
Ervin F. Johnston
ATTORNEYS

DIVING HELMET, INPUT AIR NOISE SILENCER

STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

Divers have long been plagued by the noise produced as life-sustaining air rushes from an air hose to the inside of the diving helmet. Empirically, it has been discovered that the human body can withstand only a certain amount of noise for a given period of time and exceeding these limitations results in temporary or permanent loss of hearing. Additionally, while the noise exists within a helmet, communications, between the diver and his supporting vessel, are all but impossible since this noise created by the input air turbulence is present throughout the audio spectrum and especially intense in the high audio frequency region. By way of example, during light work conditions while using a moderate air flow of 3 to 6 cubic feet of air per minute, air noise in unsilenced helmets has been measured to be as high as 110 decibels. Past experience and medical evaluations have established that certain individuals, while tolerating an exposure time of 1½ minutes of a 110 decibel noise level, suffer a temporary loss of hearing. Furthermore, during this exposure, these divers were virtually unable to audibly communicate. Attempts to reduce air flow noise in the helmet have met only with limited success since all depend on bulky external mufflerlike devices that are either prohibitively heavy or tend to impede a diver's mobility.

SUMMARY OF THE INVENTION

The present invention is directed to providing an apparatus for reducing the noise caused as a gas, air, flows from an area of high pressure to an area of lower pressure. A coupling connects the two areas and is provided with a duct that passes the gas into a tube holding hollow, cylindrically shaped sintered metal filters. The gas coming from the high-pressure area, an air line, passes through one wall of the sintered metal filter, into a diffusion chamber formed therein, and out through a second sintered metal wall. This transfer slows the air's velocity and diffuses the air flow to ensure a reduced turbulence, even flow of gas through a plurality of parallel elongate slots provided in the outer wall of the tube. Proper orientation of the tube angularly directs the air flow onto a transparent faceplate to further prevent air flow noise and to minimize the possibility of the diver's fogging the helmet's faceplate.

It is a prime object of the invention to provide an apparatus for reducing air flow noise.

Another object of the invention is to provide a compact air noise suppressor ideally suited for installation in a diving helmet.

Still another object is to provide a compact noise filter that reduces air flow noise to a low level preventing temporary or permanent loss of hearing.

A further object is to provide a noise suppressor permitting reliable, audio communications between a diver and his supporting vessel.

Yet another object is to provide an air noise suppressor capable of selective orientation for minimizing the possibility of a diver's fogging his viewing ports.

An additional object is to provide an air input noise filter of minimum bulk creating little or no physical impedance to a diver.

These and other objects of the instant invention will become readily apparent from the ensuing specification taken along with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric view of a typical diving helmet;
FIG. 2 is a sectional view taken generally along lines 2-2 in FIG. 1;

FIG. 3 is an exploded view of the invention.

PREFERRED EMBODIMENT OF THE INVENTION

Referring now to FIG. 1, a typical, representative diving helmet 10, having a neck ring 10a adapted for connection with a complimentary collar carried on a diving suit, is shown lying on its transparent faceplate 10b. An air line 11 extending to a surface compressor or similar source of pressurized air, transfers air to the helmet through an inlet fitting 13 and an inlet duct 14. An adjustable air inlet volume-control valve 12 receives the air flow to vary its volume as required by the diver. Internally mounted microphones and speakers found in most diving helmets have been eliminated from the drawings, as well as has a surface extending telecommunications line, for the sake of simplicity. On the opposite side of the helmet an air outlet valve 15, also automatically or manually adjustable by a diver, is carried to ensure that the air volume flowing through the air outlet control valve from the air inlet control valve is substantially the same. All of the many air-valving arrangements require employment of the invention since undue air flow noise is a problem in all diving helmets.

A tubular air passage duct 16 having a right-angle elbow 16a extends from the air inlet volume control valve and terminates in a flare or flanged fitting 17. A length of continuously threaded tubing 18 having threads that match a nut carried on the flanged fitting, joins the fitting to a hollow flanged coupling 19 having internal threads corresponding to those provided on the threaded tubing. The opposite end of the flanged coupling is formed as a tapered threaded portion 19a.

An air-input noise filter 20 having a hollow adapter collar 21 shaped with an internal tapered bore carrying threads corresponding to those threads disposed on the tapered threaded portion is snugly mounted to secure the filter and the above mentioned air inlet system.

Because of the passageway formed by the flanged fitting, the threaded tubing, the hollow flanged coupling, and the hollow adapted collar all have substantially the same diameter, the incoming air proceeds virtually unimpeded to the body of the air input noise filter, a tubularly shaped housing 22.

The housing is provided with a plurality of circumferentially extending parallel slots 22a arcuately defining an angle of approximately 90°. Air passing from the inside of the noise filter to the interior of the helmet must be able to pass through the slots in an unrestricted manner and, therefore, the slots are of sufficient width and length to permit free passage of the air. Optionally, air flow turbulence is further reduced by making the width of the slots on the outer surface of the housing greater than the width of the slots on the inside of the housing, permitting each slot to function as a diverging nozzle.

The overall cross-sectional area afforded by the plurality of slots is considerably greater than the cross-sectional area of the air line, and, since the same volume of gas passes through the line and the slots, the velocity of the air passing to the helmet interior must be proportionally reduced. At first glance, the problem of air noise in a helmet appears to be solved by providing these slots. However, even during light work conditions when only a moderate air flow of 3 to 6 cubic feet per minute is used, air flow noise, attributed to the rushing incoming air, is still above the safe noise exposure level. The air must be more completely diffused and dispersed as it enters the helmet.

The required diffusion and dispersion is effected by a pair of can-shaped sintered metal filters 23 and 24 each having one end open and being oriented with respect to each other in an opposed relationship to form a diffusion chamber 25. Sintered metals are formed when powdered metals are compressed into a solid mass of small particles and heated to sufficiently high temperature to form a homogeneous material having a uniform pore size, precisely controlled and determined by varying the size of the powdered metal, compression pressure, degree of temperature, or degree of temperature with time. Sintered metal, having pore sizes between 50 and 150 microns, is used in the instant noise silencer with the 150-

micron size giving the best results. Using our example air flow rate of between 3 and 6 cubic feet of air per minute, a pore size of 150 microns lowers the air flow noise between 20 and 25 decibels to a range within which a diver does not suffer a permanent or temporary hearing loss after prolonged periods of exposure.

Passing the air through a first wall 23a of metal filter 23 into diffusion chamber 25 and through a wall surface 26, consisting of the side of both filters 23 and 24, diffuses the air and slows its velocity to effect an air flow noise reduction. The elongate slots are sufficiently sized to prevent any addition of air flow noise, as do holes, but the slots are small enough to prevent undue exposure of the relatively delicate sintered metal filters to external damage.

The slots are oriented to direct the flow of air angularly onto a helmet's inner wall since a perpendicular air flow against the inner wall creates air noise within the helmet. Mounting air filter 20 inside a helmet between a diver's forehead and the helmet's top and facing the slots angularly toward the faceplate, results in the twofold advantage of first, reducing air noise by eliminating the air's direct impingement against a surface, second, and minimizing the possibility of a diver's breath from condensing on and fogging up the helmet faceplate. A precise slot facing is achieved by selectively adjusting the flange fitting 17 or by slightly overtightening or undertightening tapered threaded portion 19a into the hollow adapter collar.

Since most diving helmets have a communication system extending to the surface including a microphone and earphones within a helmet, reduction of helmet's internal air flow noise permits more reliable communications between a diver and the personnel on the surface. During times of emergency or when a diver is working strenuously, reliable communications are often paramount. A diver's quick action and heavy exertion demands more air and the air flow rate is accordingly increased with the heretofore attendant disadvantage that communications are masked by the increased air flow noise. The present invention eliminates this undesirable situation and has permitted reliable diver-surface communication.

Mounting O rings 27 between points of axial contact of the sintered metal filters helps minimize damage to the filters by resiliently seating them within housing 22 to provide a more rugged input air noise silencer capable of withstanding the operational abuses to which diving equipment is routinely subjected.

Although there has been depicted one representative diving

helmet, the invention is also ideally adapted to deep submergence hard-hat rigs or underwater habitats receiving a source of pressurized air. The popular Jack Brown-type diving mask can also be fitted with the invention to improve communications for the reasons set out above even though air input noise in a Jack Brown mask does not substantially impair a diver's hearing.

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 disclosed inventive concept the invention may be predicted otherwise than as specifically described.

We claim:

1. An apparatus for reducing the noise caused by a gas flowing from a high-pressure area to a lower pressure area comprising:

a coupling interposed between the areas formed to permit gas flow therebetween;

first and second can-shaped sintered metal filters having their open ends disposed in an opposed relationship to form a diffusion chamber, the first sintered metal filter having a first portion carried adjacent said coupling and the first and the second sintered metal filters forming a second portion shaped to cooperate with said first portion to shape said diffusion chamber; and

means enclosing the first and second can-shaped sintered metal filters connected to said coupling and provided with a plurality of slots positioned adjacent said second portion and sized, upon passing said gas flow through said first portion, into said diffusion chamber, and through said second portion, for ensuring a reduced-noise-gas-flow to said lower pressure area.

2. An apparatus according to claim 1 in which the enclosing means is an elongate tube having one end adapted for connection with said coupling and the other end closed, said slots being oriented thereon in a parallel, codirectional relationship.

3. An apparatus according to claim 2 in which said high-pressure area is the interior of an air line and said lower pressure area is the interior of a diver's helmet and said apparatus further includes:

means for orienting said slots carried on said coupling for directing said gas flow angularly onto a faceplate of said helmet preventing the generation of air noise in the helmet and preventing fogging of the helmet's faceplate.