United States Patent

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[54] AIR DISTRIBUTION PLENUM WITH SILENCER FOR HEAD ENCLOSURES

11 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** ..... **181/36 R,** 181/36 B, 181/55, 181/56, 181/60

[51] **Int. Cl.** **A42b 3/00,** F01n 1/08, F01n 7/08

[50] **Field of Search** ..... 181/36 R, 36.2, 47.1, 42, 50, 71, 46, 56, 55, 60, 33.9, 36.1

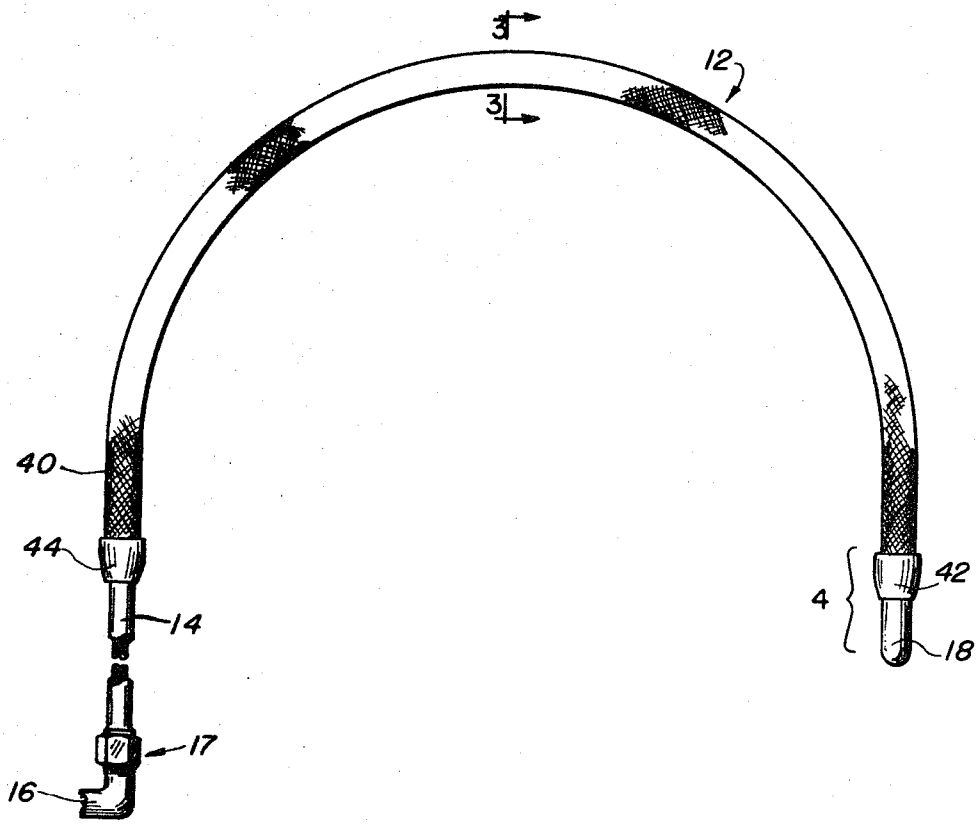
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ABSTRACT: A plenum adapted to be mounted in a head protective hood for distributing respiration air to the interior of the hood. The plenum is formed by an air distribution tube that has a plurality of air jet openings in the wall thereof and spaced along the tube to achieve a desired distribution. Fabric in the form of a sleeve disposed within the tube and overlying the air jet openings in the tube so as to break up the airflow through the jet openings to reduce noise level. A fabric sleeve disposed on the outer surface of the tube for breaking up airstreams exiting the jet openings in the tube. Structure for supporting the fabric sleeves in their respective positions.



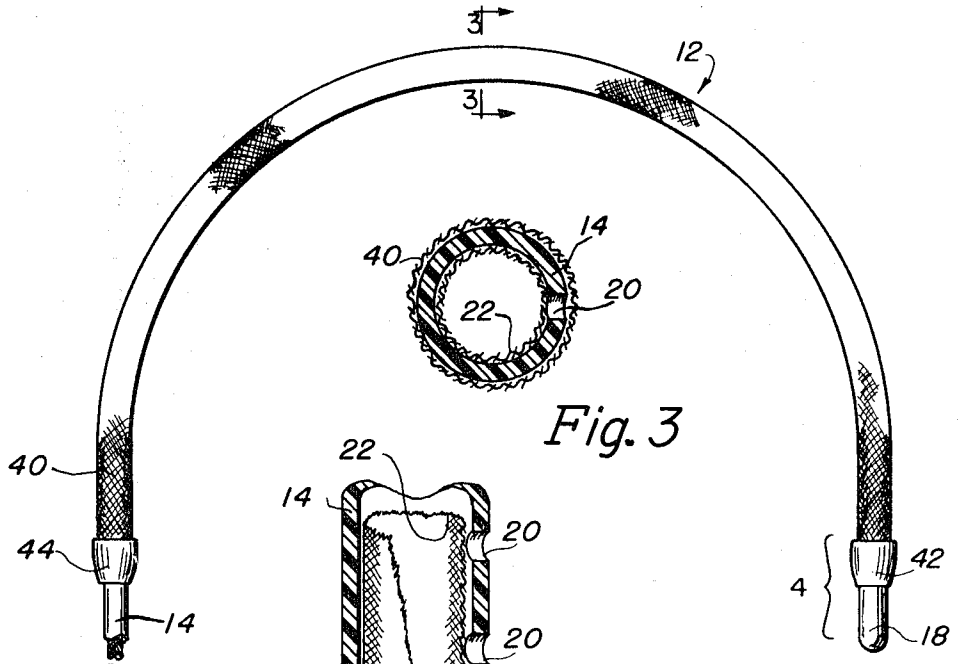
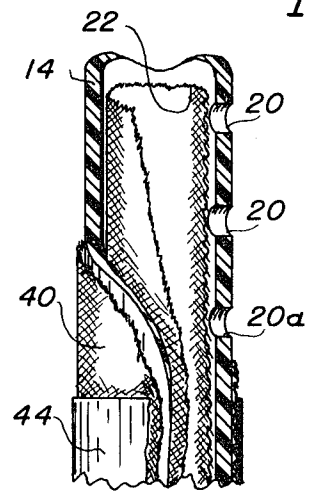


Fig. 3

Fig. 1



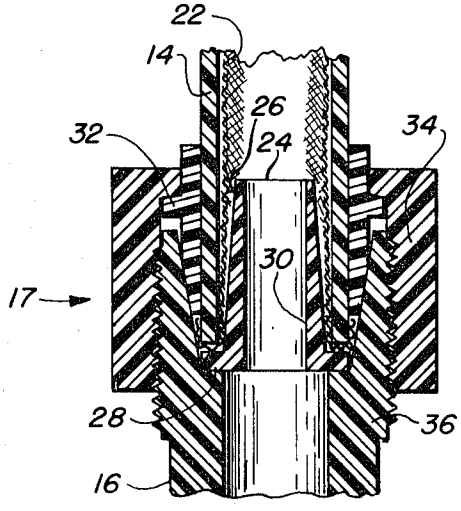


Fig. 2

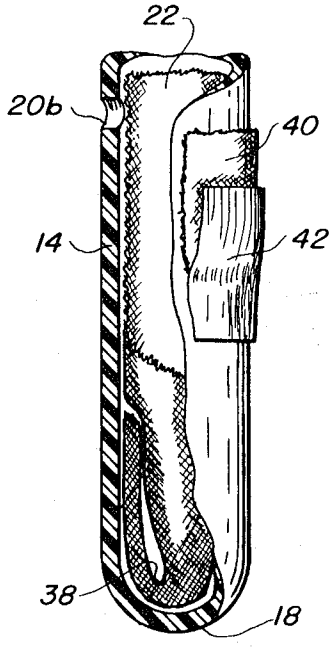


Fig. 4

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AIR DISTRIBUTION PLENUM WITH SILENCER FOR HEAD ENCLOSURES

This invention relates to an air distribution plenum for head enclosures of the type worn by sandblasters and more particularly to an air distribution plenum that distributes adequate respiration air without producing an excessive noise level.

Health and safety requirements dictate that those working in atmospheres having deleterious airborne substances wear a head enclosing hood to the interior of which pure respiration air is supplied. Supply of air to the enclosure is typically achieved by delivering the air through a tube which has one or more openings through which air egresses to the interior volume of the enclosure. Unless special precautions are taken, such air as it exits the tube produces a whistlelike sound at an audible level that is bothersome and fatiguing to the wearer of the enclosure. A specific maximum noise level, as specified in regulations promulgated under the aegis of the United States Secretary of Labor, is 90 decibels (db.), such regulations prescribing that those exposed to a noise level in excess of 90 db. must be given frequent rest periods to avoid permanent adverse effects from such excessive noise level.

An object of the present invention is to provide an air distribution plenum for head enclosures that avoids production of noise levels in excess of 90 db. In fact the noise level produced when employing a preferred embodiment of the present invention limits the noise level to well under 80 db., a level that is not bothersome or hazardous to the user of an enclosure employing the invention.

A satisfactory form of the invention includes a hollow semirigid plastic tube mounted within a head protective enclosure above the face of the wearer of the enclosure. Through the wall of the tube is formed a plurality of downwardly directed air jets that direct air down over the face of the wearer. The end of the tube terminates exterior of the enclosure at which it is provided with an air fitting or coupling to which a hose from an air delivery system is connected. According to the present invention, the interior of the tube, at the region thereof where the air jet openings are formed, is provided with a fabric sleeve, the individual fibers of which are spaced from one another to form pores that have a size much less than the diameter of the air openings. Upstream of the region where the air openings are formed in the tube, the fabric sleeve is secured within the tube so that air passing through the tube must flow through the spaces between the fibers of the sleeve in order to reach the air outlet openings in the tube wall. Such structure is thought to break up the flow of air to such a degree that the noise level is materially reduced. Also included in the preferred embodiment of the present invention is a second fabric sleeve secured to the exterior surface of the tube for contributing to accomplishment of the same purpose, as the air exits the openings in the tube wall.

Another object is to provide an air distribution plenum that affords the above-described advantages in a simple and inexpensive structure. Contributing to the achievement of this object is the provision of a flanged cylindric insert that fits into the air distribution tube at the inlet end thereof. The inner fabric sleeve is held captive between the tube all and the insert by compressive forces arising as the insert is pressed into the end of the tube. Not only does the insert fix the inlet end of the sleeve but it assures that all air entering the device will pass through the pores of the sleeve before the air escapes through the jet openings in the tube wall.

The foregoing together with other objects, features and advantages of the invention will be more apparent after referring to the following specification and accompanying drawing in which:

FIG. 1 is a top view of an air plenum according to the present invention;

FIG. 2 is an enlarged view of the inlet end of the plenum of FIG. 1, portions being broken away to reveal internal details;

FIG. 3 is a cross section taken along line 3—3 of FIG. 1; and

FIG. 4 is a view of the end of the plenum opposite the inlet end with portions broken away to reveal certain internal details of construction.

Referring more particularly to the drawing, reference numeral **12** indicates an air distribution plenum according to the present invention that is intended for installation in a head protective enclosure. Such enclosure is not further shown or described, since it forms no part of the invention. The plenum is formed by a relatively rigid plastic air distribution tube **14** to which is connected an air delivery tube **16** the remote end of which is supplied with filtered air from a compressor and filter system not shown. A joint **17** is provided for connecting air delivery tube **16** to air distribution tube **14**. The end of air distribution tube **14** remote from connection **17** is closed, as at **18**, and the walls of tube **14** are provided with a series of air jet openings **20** so that air supplied to the interior of the air distribution tube is distributed through openings **20**. Air plenum **12** is typically installed in an enclosure above the face of the wearer with air jet openings **20** directed downward so that a stream of fresh air is directed over the face of the wearer. Mounted within air distribution tube **14** is a fabric sleeve **22** that overlies the interior of air jet openings **20** so as to break up the air entering the openings and thereby reduce the noise level. The pores or interstices between the threads that form inner sleeve **22** are of a dimension materially less than the diameter of air jet openings **20** so that the air is broken up into a series of extremely small streams which contributes to noise reduction. Also contributing to noise reduction is the fact that the threads or fibers constituting the inner tube are soft and substantially devoid of sharp edges.

For securing inner sleeve **22** within tube **14** and assuring that air supplied to the tube is directed to the interior of the sleeve, there is included an insert fitting **24** formed by a generally cylindric portion **26** and an annular flange **28**. The outer diameter of cylindrical portion **26** is less than the inner diameter of air distribution tube **14**, and the outer diameter of flange **28** is greater than such inner diameter so that axial movement of insert **24** is limited by the flange. Moreover, the external surface of cylindric portion **26** is provided with a slight taper to expedite assembly of the air plenum. As shown in FIG. **2**, the outer diameter of cylindric portion **26** is sufficient to admit sleeve **22** between the insert and tube **14** but is large enough to snugly engage the sleeve to prevent movement thereof. Insert **24** is provided with a central opening **30** to admit air from air delivery tube **16** to the interior of sleeve **22**. For joining air delivery tube **16** to air distribution tube **14**, a tapered annulus **32** of conventional form is provided in circumscribing relation to the air distribution tube and an interiorly threaded nut **34** has a surface complemental to the tapered surface of annulus **32** so that axial force on the nut compresses the annulus to form an airtight seal. The end of air delivery tube **16** is male-threaded at **36** to engage the threads on nut **34** thereby completing the connection. It will be noted that the end of air delivery tube **16** can be formed with a flat face to urge insert **24** into its operative position within air distribution tube **14**. Thus, joint **17** connects the air delivery tube to the air distribution tube, establishes air flow therebetween, and assists in retaining the inlet end of sleeve **22** in its operative position.

Sleeve **22** at the end thereof remote from joint **17** is folded back over itself as indicated at **38** in FIG. **4**. The amount of the sleeve that is folded back on itself is preferably short enough that the last air jet opening **20***b* is not obstructed by more than a single layer of the material of which the sleeve is formed. The folded-over length must be sufficient, however, to avoid escape of air through the longitudinal end of the sleeve and to support the end of the sleeve adjacent end **18** of air distribution tube **14**.

It has been found that sleeve **22** installed as described above is sufficient to reduce the noise level produced by air passing through jet openings **20** to a level below 90 db. A further reduction is achieved, however, by securing to the outer surface of air distribution tube **14** an outer fabric sleeve **40**. Outer

sleeve **40** is secured in place by flexible adhesive-bearing tape **42** and **44** which is wrapped around the ends of sleeve **40** outside of the extreme jet openings **20***a* and **20***b*. Outer tube **40** is of a character and function similar to inner sleeve **22** in that the size and texture of the individual threads that constitute the outer sleeve are sufficient to break up the airstream that egresses from each air jet opening **20** whereby noise is reduced or eliminated.

Certain techniques of assembly have been developed which contribute to the advantageous characteristics of the present invention. Installation of inner sleeve **22** has been successfully achieved by first cutting the sleeve to proper length and then inserting into the inner opening of the sleeve a relatively rigid rod. The folded back portion **38** of the sleeve is formed by folding the sleeve back over the end of the rod and then the sleeve and rod are inserted into air distribution tube **14**. When the rod bottoms against end **18** of tube **14**, the rod can be removed without dislodging the inner sleeve. Thereafter, the opposite end of the sleeve is folded over the end of tube **14** adjacent joint **17**, and insert **24** is inserted to retain firmly the inner sleeve in place. For installing the outer sleeve, it is preferred that the sleeve be moved into place in circumscribing relation to air distribution tube **14** after which one end, for example the end indicated in FIG. **4**, is secured by wrapping tape **42** therearound. As shown, the tape overlaps the end of the sleeve so as to achieve adherence to the surface of tube **14**. Then the sleeve **40** is stretched axially thereof until it is in tightly embracing relation to the exterior surface of air distribution tube **14** whereupon the opposite end is fixed by wrapping tape **44** therearound.

For exemplifying without limiting the present invention, the following dimensions of one satisfactory embodiment of the invention are disclosed. Air distribution tube **14** is formed of plastic tubing having a nominal inside diameter of one-fourth inch and an outside diameter of three-eighths inch. Air jet openings **20** are 50 in number and have a 1/16-inch diameter spaced apart on centers by a distance of three-sixteenths inch. The length of air distribution tube **14** is sufficient to extend around at least the front region of the head enclosure. Inner sleeve **22** and outer sleeve **40** are formed of nominal ⅜-inch inside diameter cotton sleeving. Insert **24** has an outside diameter suitable for compressing sleeve **22** and securing it against movement and inner diameter of air passage **30** in the insert is approximately three-sixteenths inch.

In using air plenum constructed according to the present invention, the air plenum is installed in a helmet or like head protective enclosure by suitable clamps or the like at a position preferably located above the face of the wearer of the enclosure. The plenum is oriented so that air jet openings **20** are directed in a downward direction. Air delivery tube **16** is passed through a suitable opening in the enclosure and is connected by way of a hose or the like to a suitable source of filtered air. The air supply is turned on to a level suitable to afford adequate ventilation and respiration to the user of the device and it has been found that the noise level of the air entering the enclosure from the plenum of the invention does not exceed a figure well below 90 db. Accordingly, use of the present invention fulfills all safety requirements and provides a structure that is far less fatiguing and bothersome to the wearer of an enclosure than heretofore.

Although one embodiment of the invention has been show and described, it will be obvious that other adaptations and modifications can be made without departing from the true spirit and scope of the invention.

What is claimed is:

1. Apparatus for distributing air within a closed volume comprising a hollow distribution tube having an inlet end for receiving air, said tube having a wall defining a plurality of air openings for communicating air from the interior of the tube to the volume, an air-pervious fabric sleeve disposed within said distribution tube and extending from said inlet end to said openings, and means for fixing said sleeve adjacent said inlet end of said distribution tube so that air introduced in said inlet flows through said sleeve to said air openings.

2. The invention of claim **1** wherein said sleeve fixing means comprises a rigid cylinder having an outer surface sized to enter said hollow distribution tube, said cylinder being disposed within said distribution tube at the inlet end thereof and frictionally engaging said sleeve between the outer surface of said cylinder and the inner surface of said distribution tube, said cylinder having an opening therethrough for admitting air interior of said sleeve.

3. The invention of claim **2** wherein said cylinder includes a circular flange at the outer end thereof for limiting movement of said cylinder inward of said distribution tube.

4. The invention of claim **3** in combination with an air delivery tube for delivering air through the opening in said cylinder, said air delivery tube terminating in a flat face transversely thereof, and means for retaining said air delivery tube so that said flat face bears against said flange to retain said cylinder in place within the inlet end of said air delivery tube.

5. The invention of claim **1** wherein said air distribution has a closed end remote from said inlet end, and means for supporting said fabric sleeve adjacent said closed end.

6. The invention of claim **5** wherein said supporting means comprises an end portion of said sleeve folded back upon itself adjacent said closed end to form a region within said air distribution tube that contains a double thickness of said sleeve.

7. The invention of claim **1** in combination with a second fabric sleeve disposed in circumscribing relation to the outer surface of said air distribution tube and overlying the air openings in said tube, and means for securing said second sleeve in place.

8. The invention of claim **7** wherein said second sleeve securing means comprises adhesive bearing tape wrapped around the ends of said second sleeve, said tape overlapping the respective ends of said second sleeve and being adhesively joined to the outer surface of said air distribution tube.

9. A method for reducing the noise level of air supplied to the interior of a head enclosure through an opening in a cylindric wall comprising the steps of providing a fabric sleeve having fibers of a diameter less than the opening that are spaced from one another by an amount less than the opening, inserting the sleeve within the cylindric wall so that the fabric overlies the opening, and confining incoming air to the interior of the sleeve.

10. The invention of claim **9** wherein said inserting step comprises providing a relatively rigid rod having an outer dimension less than the inner diameter of the cylindric wall and of the sleeve, inserting the rod in the sleeve, inserting the rod and sleeve into the interior of the cylindric wall, and then removing the rod.

11. The invention of claim **9** wherein air confining step comprises the steps of providing a cylinder having a central opening and an outer diameter slightly smaller than the interior diameter of the cylindric wall, compressing the sleeve between the outer diameter of the cylinder and the interior diameter of the cylindric wall at a site remote from the opening in the cylindric wall, and directing incoming air through the central opening in the cylinder.