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Rosendahl et al.

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[54] **HARD HAT AIR CURTAIN**

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[52] **U.S. Cl.**..... **128/145 R;** 128/142.7; 2/171.3; 2/3 R

[51] **Int. Cl.** **A61f 9/06**

[58] **Field of Search** ..... 128/145 R, 142.3–142.7, 128/142, 139; 2/5, 9, 171.3

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Assistant Examiner—Henry J. Recla
Attorney, Agent, or Firm—Merchant, Gould, Smith & Edell

[57] **ABSTRACT**

An improved industrial helmet for protecting the wearer against inhalation of air-borne particulate matter, the helmet having a bill provided, along its outer edge, with a member creating a high velocity air curtain enclosing the wearer's face and attaching thereto only at the sides, and further provided, over a major portion of its lower surface, with diffuser means supplying low velocity inhalation air to the wearer within the curtain. Air supplied at a single rear inlet connection is split and passes around the sides of the helmet through a double manifold: at the front the rejoined air stream is again split by a perforated partition to supply the high velocity outlet and the low velocity outlet separately. The air curtain member which creates the high velocity curtain is reentrant within the shell of the helmet at its ends, and tabs outside the helmet are provided to limit the forward extent to which the curtain attaches to the wearer's face.

10 Claims, 6 Drawing Figures

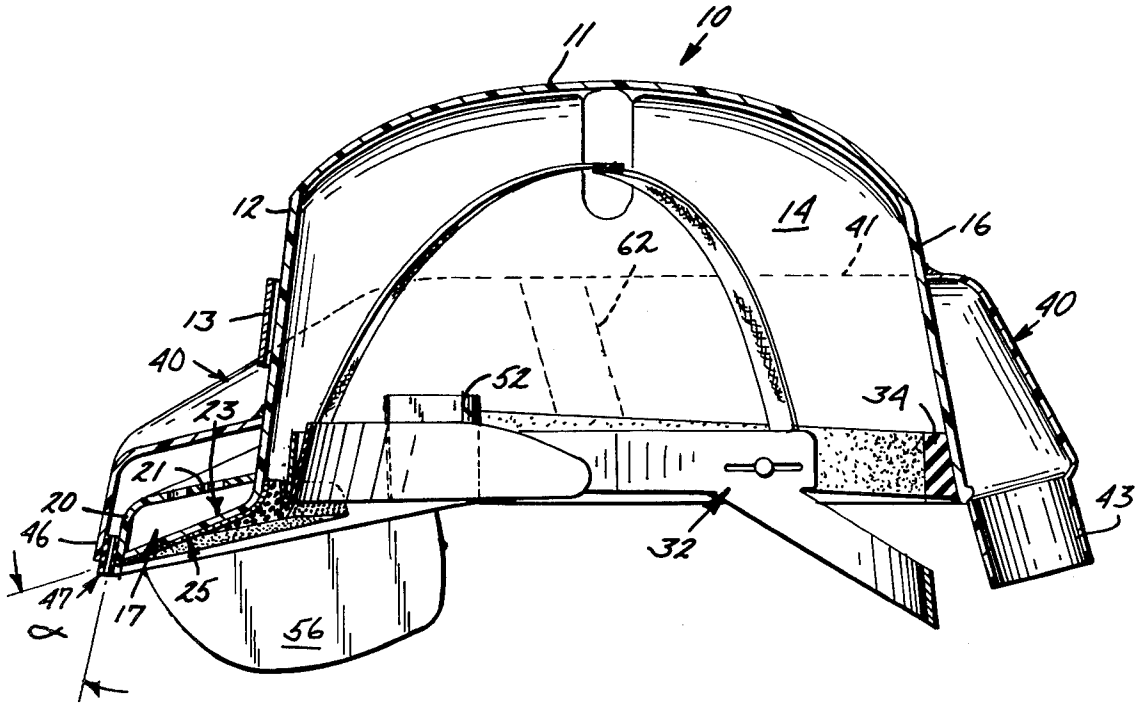


FIG. 1

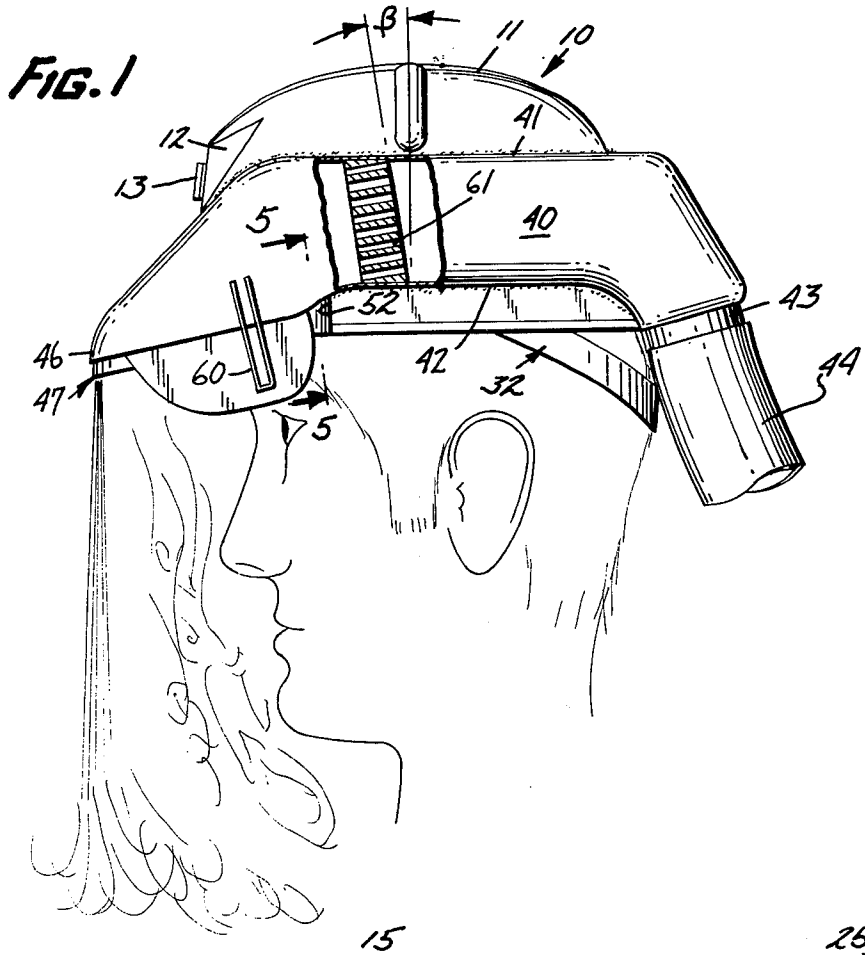


FIG. 6

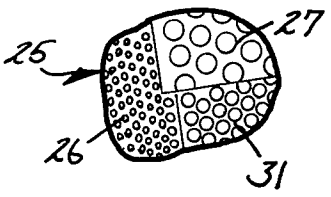


FIG. 5

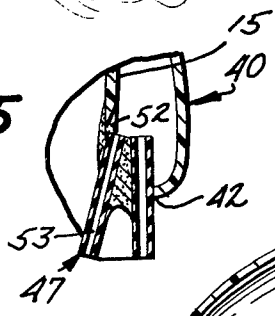


FIG. 4

FIG. 2

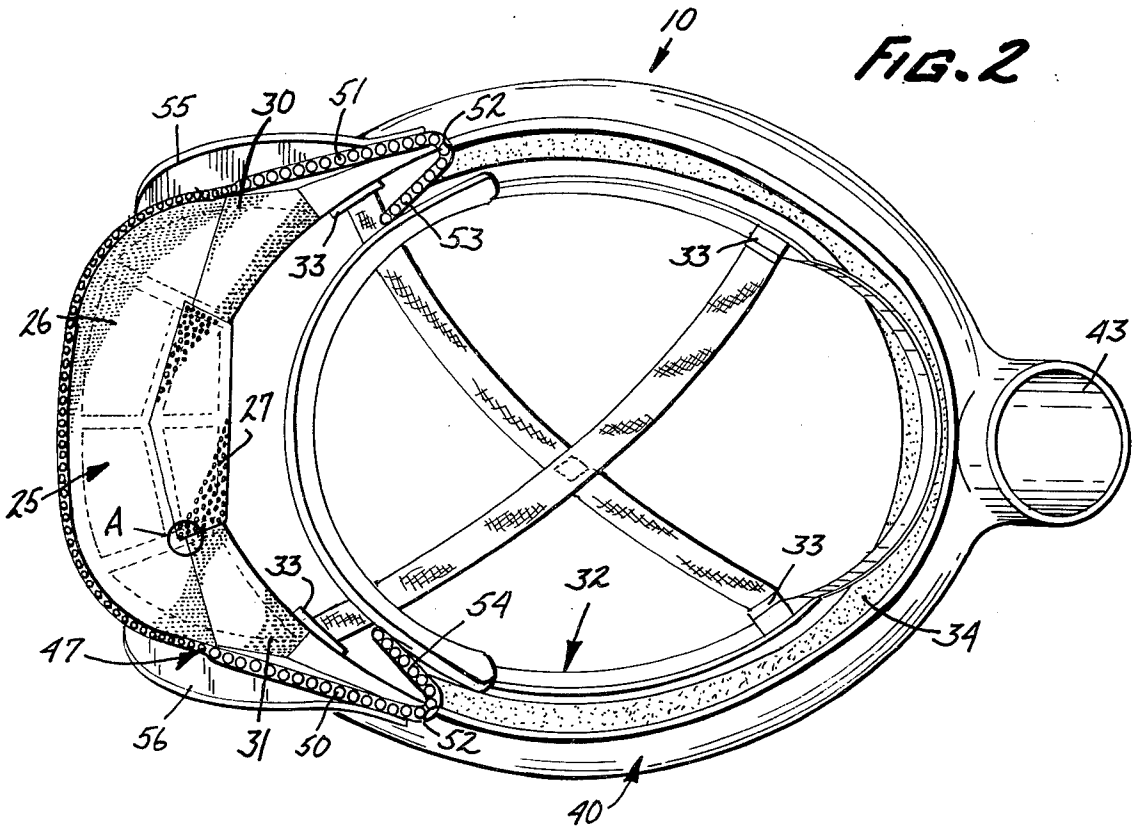
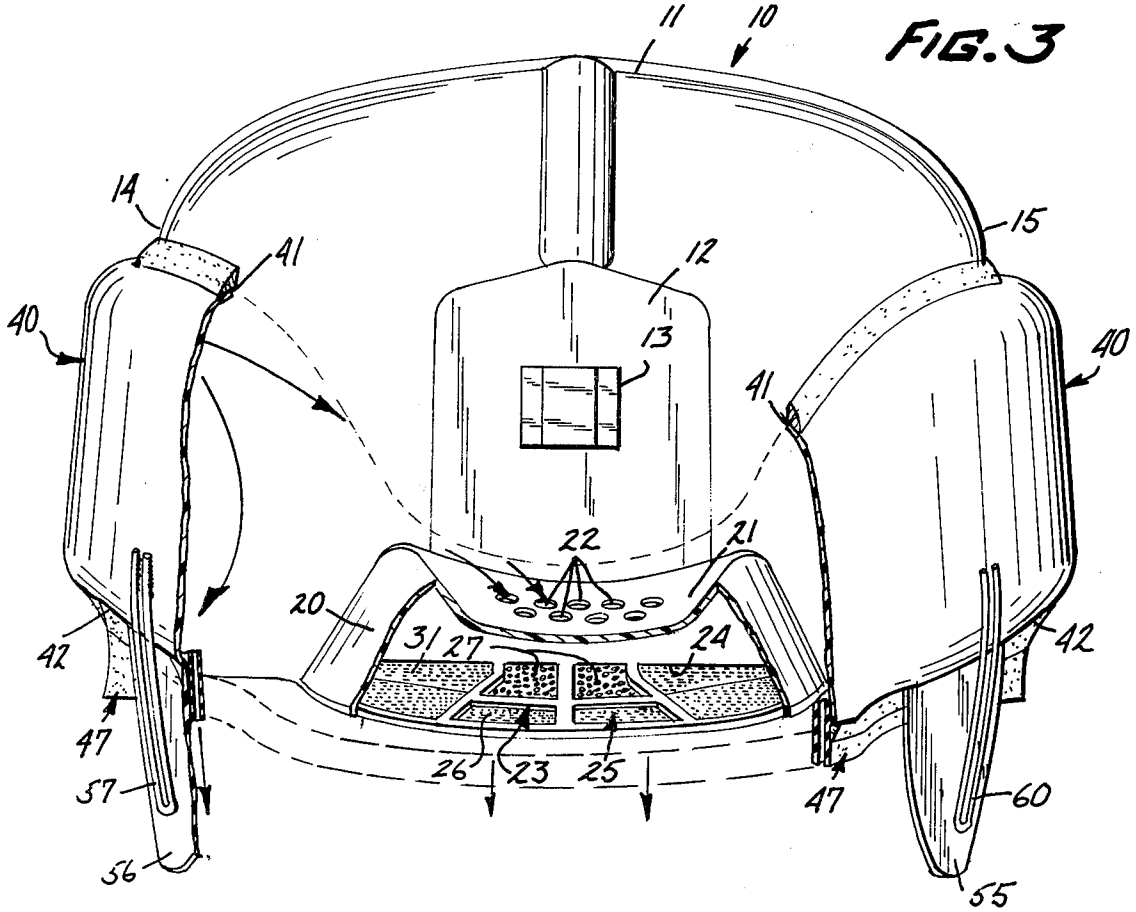

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FIG. 3


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HARD HAT AIR CURTAIN

This invention resulted from the work done under contract HO 122087 with the Bureau of Mines in the Department of the Interior and is subject to the terms and provisions of the President's Patent Policy Statement of Oct. 10, 1963.

BACKGROUND OF THE INVENTION

This invention pertains to the field of industrial safety and particularly to helmets for use by workers in hazardous areas to protect them against the inhalation of air containing particulate matter in the form of dust or aerosols.

The need for improved protection of workmen from inhalation of respirable dust in coal mining operations is recognized by industry, and considerable effort is presently being exerted to find practical solutions. Inhalation of such dust causes a respiratory disease called pneumoconiosis or "black lung" disease.

Several approaches have been taken to accomplish the desired protection. The present invention relates to one approach, that of providing the workman with a personal respiratory protection device continually supplied with clean breathable air from a suitable source which of itself does not form a part of the invention.

The concept of providing an air curtain around the face of a person to protect him against dust is known, and it is also known that such arrangements can advantageously include a separate supply of inhalation air within the air curtain.

SUMMARY OF THE INVENTION

The present invention comprises a practical embodiment of the principles just mentioned in an industrial helmet of unitary construction. It receives its breathable air at a single location, through a connection which is readily interruptable in case of emergency. The inlet air is supplied through a dual or split manifold running around the outside of the helmet shell on both sides, and containing honeycomb inserts to improve the direction of air flow, to a chambered bill on the helmet where the air is again divided into a high velocity discharge around the edge of the bill, which forms the desired air curtain enclosure around the face, and a low velocity discharge through a diffuser making up the bottom of the bill, which supplies inhalation air for the wearer within the curtain. The air curtain member is specially constructed with apertures of different sizes, and with ends reentrant through the helmet shell to give an air curtain which attaches to the sides of the wearer's face due to the Coanda attachment phenomenon of flowing fluids, thus preventing lateral entrance of contaminated air, and means are further provided to limit the forward extent ot the fluid attachment with the face.

It is accordingly an object of the invention to provide an improved industrial helmet for use in atmospheres laden with dust.

It is another object of the invention to provide such a helmet with improved means for creating an air curtain and supplying inhalation air within the curtain.

Another object of the invention is to provide such a device having improved means for creating an air curtain which attaches to the wearer's face at a desired location and to a controlled extent.

Yet another object of the invention is to provide such a device in which the inhalation air is supplied through a diffuser occupying substantially the entire lower surface of a projecting bill which gives air flow at different velocities at different locations of the diffuser.

Various other objects, advantages, and features of novelty which characterize my invention are pointed out with particularity in the claims annexed hereto and forming a part hereof. However, for a better understanding of the invention, its advantages, and objects attained by its use, reference should be had to the drawings which form a further part hereof, and to the accompanying descriptive matter, in which there is illustrated and described a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, FIG. 1 is an elevation of my improved helmet in use;

FIG. 2 is a bottom view of my helmet;

FIG. 3 is a front view of my helmet, parts being broken away for clarity of illustration;

FIG. 4 is a longitudinal vertical central section of my helmet;

FIG. 5 is a fragmentary section along the line 5—5 of FIG. 1; and

FIG. 6 is a detail at A in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to the drawings, my helmet is shown to comprise a shell 10 of light rigid material having a crown portion 11, a front portion 12 carrying a lamp mounting clip 13, side wall portions 14 and 15, a rear wall portion 16, and a chambered bill 17.

Bill 17 is shown to have a solid front wall 20, a top 21 with perforations 22, and an open grillwork bottom 23 extending from the bottom of front wall 20 to the bottom 24 of front portion 12, which is somewhat higher here than the bottoms of the remaining wall portions. Secured to the under surface of grillwork 23 and to the bottom 24 of the front wall portion of the shell is a diffuser 25 made up of a pattern of sheets of microperforated stainless steel. A first sheet 26 of the material having the finest pores covers the front portion of the bill, a second sheet 27 of the material covers the rear center portion of the bill and has larger pores, and two further sheets 30 and 31 of the material cover the rear side portions of the bill and have pores of intermediate size. This is suggested by FIG. 6. The sheets making up diffuser 25 may be secured to the grillwork and to each other by a suitable adhesive.

Internally the helmet includes an adjustable suspension arrangement 32 secured thereto at 33 for supporting it securely on the head of a wearer as shown in FIG. 1, and a resilient band 34 is provided within the rim of the shell to seal the space within the helmet against rearward entrance of dust laden air to pass over the wearer's head and so into his breathing space.

Cooperating with shell 10 is a manifold 40 in the form of an inwardly concave member of light, rigid material which surrounds the shell and is securely sealed thereto along a top edge 41 and a bottom edge 42. At the rear of the helmet manifold 40 is provided with a hose connection 43 for receiving a hose 44 from a source of clean air of any suitable type. The hose is conventionally provided with a quick disconnect de-

vice, which is usually attached to the wearer's belt, to enable him to free himself from the source in case of emergency.

The lower front rim **46** of manifold **40** is sealed to the front wall **20** of bill **17** by an air curtain member **47** which comprises a strip of flexible material having a plurality of parallel tubular passages extending therethrough in a downward and outward direction as shown in FIG. **4**, where the angle α may be, for example 60°. The passages are of different sizes, those along the front of the helmet being smaller than those at the sides, as shown at **50** and **51** respectively in FIG. **2**. The ends of member **47** are reentrant through slots **52** in the lower edges of side portions **14** and **15**, to continue in a forward direction for a short distance within the shell, as at **53** and **54** in FIG. **2**, for a purpose presently to be explained. Member **47** forms a part of the seal between the lower edge of manifold **40** and the lower portion of the helmet, and all joints therebetween are carefully sealed with a suitable adhesive material. The member is reentrant or inwardly hooked at its ends to ensure that a stream of air emerging therefrom attaches to the wearer' s temporal region, due to the Coanda effect of flowing fluids, and flows down the side of his face. This provides a facial "seal" of air that prevents environmental air from mixing with the inhalation air within the curtain.

On each side of the helmet tabs **55** and **56** are secured to manifold **40** and member **47** to extend downwardly therefrom. The tabs are supported against outward displacement away from the helmet by loops **57**, 60 of resilient cable adhesively secured to the outer surface of manifold **40** and depending to bear against the tabs.

A pair of partitions **61** and **62** of honeycomb material are advantageously inserted in the sides of manifold **40** for the purpose of improving the air flow therein. The parallel passages in these partitions extend in a slightly downward direction as suggested by the angle β in FIG. **1**, which may for example be 9°.

OPERATION

In use the wearer adjusts suspension arrangement **32** to fit his head so that the helmet is secure, and attaches a hose to connection **43**. Air now flows into the manifold and moves around the helmet in two streams, passing through elements **61** and **62** which improve the flow by influencing its direction and suppressing turbulence. This arrangement avoids increasing the height of the helmet, thus lowering its center of gravity to minimize top-heaviness, and improve comfort and stability, while still allowing the input connection to be at the back, out of the workman's way. The angle of hose connection **43** is intended to minimize interference by the helmet with the operator's freedom by allowing for more movement of his head if he has occasion to tip it back. The two streams of air come together over the bill of the helmet. Part of the air flow passes out through the passages in member **47** as a high velocity sheet of air and part of the air passes through the perforations **22** and diffuser **25** as a low velocity core of air. The high velocity flow forms an air curtain enclosing the face of the wearer, the velocity of the air being slightly less at the sides where the air flow must attach to the face of the wearer to seal out the dustladen ambient air. It is to insure this attachment that the ends of member **47** are made reentrant. Nevertheless the flow should not continue to attach to the face too far forward: to prevent this tabs **55** and **56** are positioned so that the flow through member **47** attaches to them before it can attach to the face, and subsequently becomes a free expanding (non-attached) air stream as it leaves the lower edge of the tabs thus determining the forward limit of attachment of the air flow to the face.

Within the air curtain inhalation air is supplied to the user through diffuser **25** at low velocity. I have found it desirable to have the inhalation air delivered at different velocities, which are determined by the sizes of the microperforations in the diffuser. The least velocity is found near the front edge of the bill, and greater velocities are provided near the wearer's face. It is to be noted that the sheets **27**, **30** and **31**, extending rearwardly, have upward turns near the wearer's forehead, so that some air is directed inward.

Numerous objects and advantages of my invention have been set forth in the foregoing description, together with details of the structure and function of the invention, and the novel features thereof are pointed out in the appended claims. The disclosure, however, is illustrative only, and changes may be made in detail especially in matters of shape, size, and arrangement of parts, within the principle of the invention, to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. In an industrial helmet for protecting the wearer against inhalation of air-borne particulate matter, in combination:

an impact resistance shell carrying internal suspension means for mounting the helmet on the head of the wearer and comprising crown, front, side, and back portions and a chambered bill portion having a front wall, a perforated top, and a grillwork bottom extending from the rim of said front wall to the rim of said front portion to define the chamber of said bill;

an inwardly concave member surrounding said shell and sealed along a top edge to the walls of said shell and along a bottom edge to the front wall of said bill and the side and rear walls of said shell to define a manifold;

coupling means for receiving air supplied to said manifold;

an air curtain member forming a part of the seal between said manifold and the front wall of said bill, and comprising a strip of material having a plurality of parallel tubular passages extending therethrough and directed downwardly along the front of said bill to provide a high velocity output for air from said manifold in the form of an air curtain encircling the wearer's face;

and diffuser means secured to the grillwork bottom of said bill and the front wall of said shell to provide a low velocity output of air passing through the perforations in the top of said bill from said manifold, whereby to constitute a supply of inhallation air within said air curtain.

2. The structure of claim **1** together with tabs depending from said helmet outside said air curtain member for attachment by the high velocity air from said curtain member.

3. The structure of claim **2** together with resilient means supporting said tabs against outward displacement away from said helmet.

4. The structure of claim 1 in which the tubular passages of said air curtain member are of smaller diameter in the front of said bill than at the sides thereof.

5. The structure of claim 1 in which the shell is provided with slits at the bottom of the side walls thereof and said air curtain member is reentrant at its ends, passing through said slits and continuing forwardly inside said shell.

6. The structure of claim 5 in which the passages in the reentrant portion of said air curtain member are larger than those near the center of the bill.

7. The structure of claim 1 in which said diffuser means comprises at least one sheet of microperforated metal.

8. The structure of claim 1 in which said diffuser means comprises a plurality of sheets of microperforated metal having perforations of different sizes.

9. The structure of claim 1 in which the diffuser means comprises a sheet of microperforated metal having small perforations along the front of said grillwork, sheets of similar metal of larger perforations at the sides of said grillwork, and a sheet of similar metal having still larger perforations at the center of said grillwork next to the front wall of said shell.

10. The structure of claim 1 in which said manifold includes a partition of honeycomb diffuser material on each side of said helmet to direct the flow of air therethrough.

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