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H. I. REYNOLDS

3,521,629

HEAT AND SMOKE PROTECTIVE HOODS

Filed Sept. 18, 1967

2 Sheets-Sheet 1

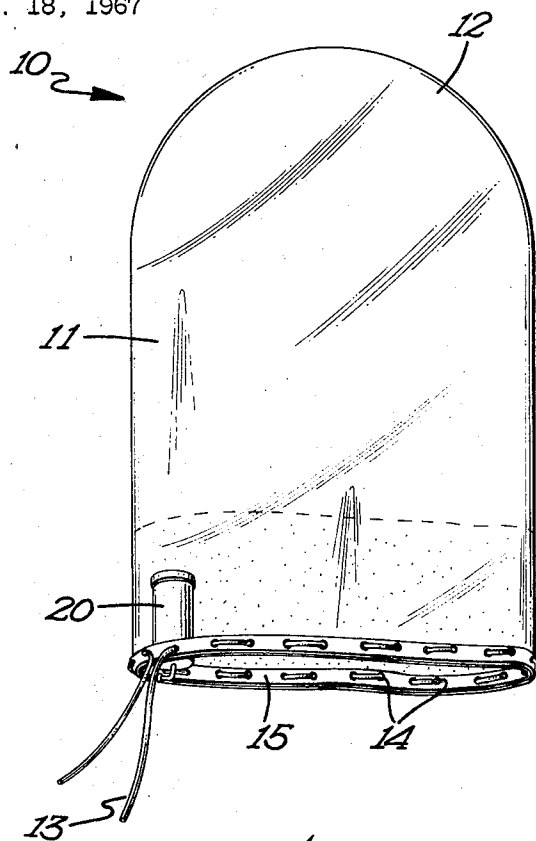


FIG 1

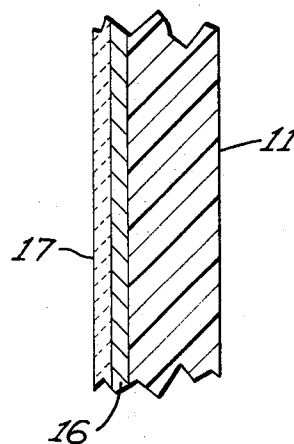


FIG 4

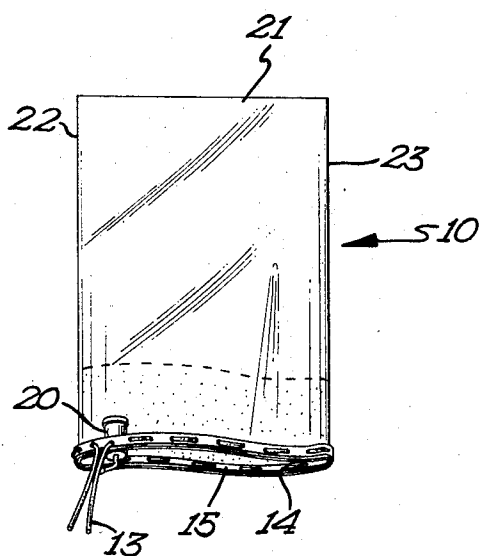


FIG 3

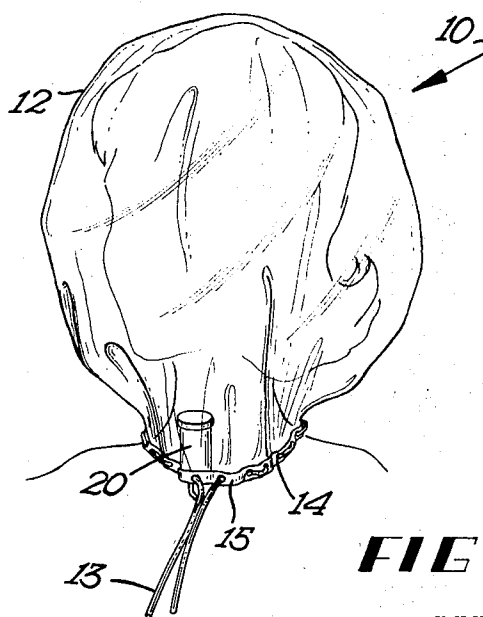


FIG 2

INVENTOR.

HAROLD I. REYNOLDS

BY

Adams, Cwayma
& Haugen

ATTORNEYS

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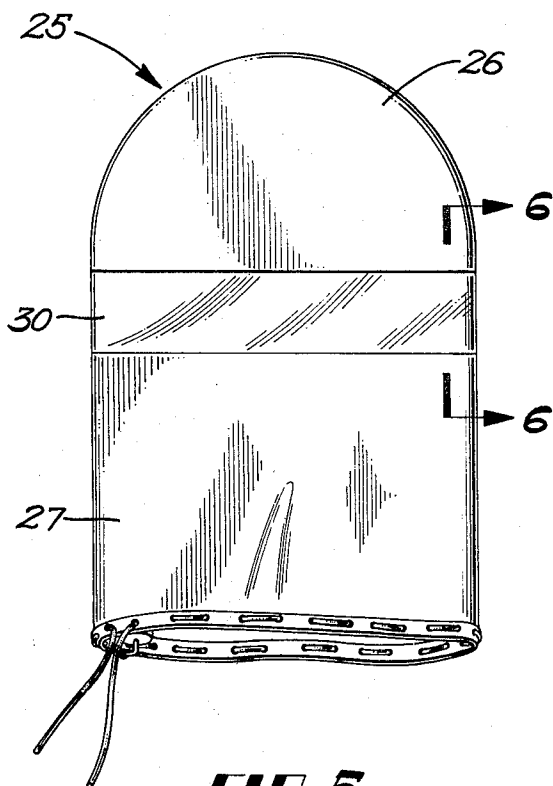


FIG 5

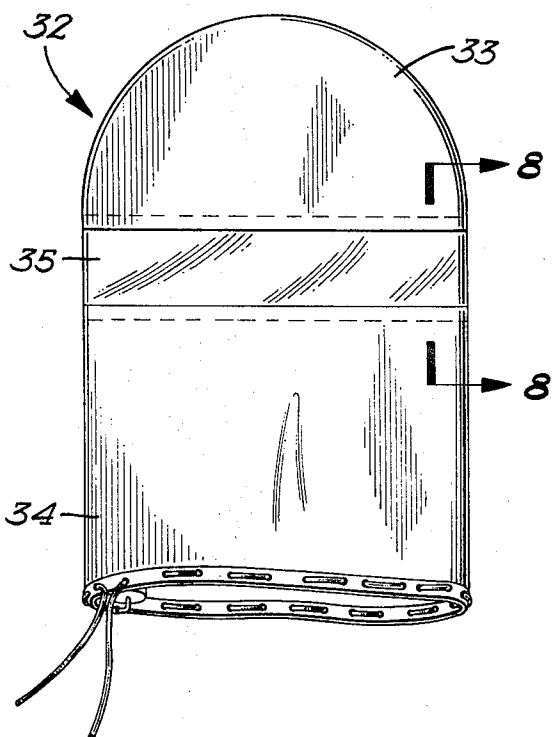


FIG 7

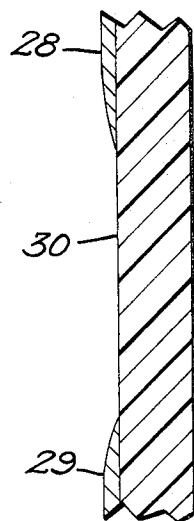


FIG 6

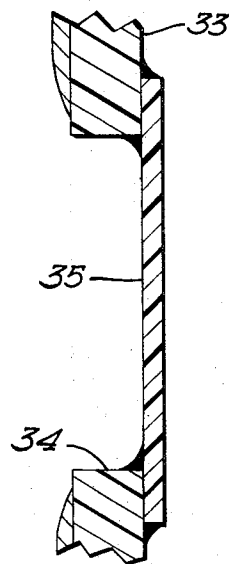


FIG 8

INVENTOR.
HAROLD I. REYNOLDS
BY
*Adams, Lawayna
& Haugen* ATTORNEYS

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3,521,629

HEAT AND SMOKE PROTECTIVE HOODS

Harold I. Reynolds, Mercer Island, Wash., assignor to G. T. Schjeldahl Company, Northfield, Minn., a corporation of Minnesota

Continuation-in-part of application Ser. No. 624,448, Mar. 20, 1967. This application Sept. 18, 1967, Ser. No. 668,738

Int. Cl. A62b 17/04

U.S. Cl. 128—142.7

13 Claims

ABSTRACT OF THE DISCLOSURE

A protective hood enclosure adapted to be worn by an individual within a flame or smoke-laden environment, the enclosure being fabricated from a gas impermeable flexible film of transparent heat resistant material, the film being provided with an infra-red reflective metal along the outer surface thereof.

The present application is a continuation-in-part of my co-pending application Ser. No. 624,448 filed Mar. 20, 1967, now abandoned entitled "Heat and Smoke Protective Hoods," and assigned to the same assignee as the present invention.

The present invention relates generally to an enclosure or protective hood device which may be utilized for covering and enclosing the wearer's head, this hood being fabricated from a gas impermeable flexible film of visibly transparent but heat resistant material. The unit is particularly adapted for use in an emergency situation, such as, for example, an airplane crash or other catastrophic occurrence.

It has been ascertained that passengers in tragedies such as crashes of aircraft or the like frequently survive the impact, but are found to have perished in the aftermath of the flame, smoke, or other noxious conditions. In order to assist those survivors in being able to abandon or otherwise leave or evacuate the environment, a hood enclosure has been designed to be worn by these survivors, this hood providing a sufficiently sound protective barrier to assist the wearer for a limited period of time while evacuating the immediate area. This particular enclosure is sufficiently heat resistant and reflective to infra-red so as to provide a maximum degree of protection for a limited period of time. Obviously, in such a situation, several minutes of protection may be reasonably adequate to provide evacuation of survivors from a flaming wreckage situation.

Briefly, in accordance with the present invention, a protective hood enclosure is provided which is fabricated from a gas impermeable flexible film of transparent but heat resistant material. Such films of material are now commercially available, one such film being that certain film fabricated from polyimide (amide) substances as disclosed in U.S. Pat. No. 2,867,609 and the like, this being a film of polypyromellitimide. In order to assist the film material in being visible but yet reflective to infra-red radiation, a visibly transparent protective film of a metal such as aluminum, silver, gold or copper is applied to the surface, and substantially the entire outer surface of the enclosure. In order to protect the reflective qualities of the infra-red reflective metal, a protective film is applied to the surface of the metal. Thus, oxidation or sulphiding are avoided.

In order to reduce costs, it is possible to fabricate the hood from different materials, combined together to form a gas impermeable transparent hood enclosure. In this connection, the cap portion and the neck portion may be fabricated from one material, while the portion about

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the wearer's eyes may be fabricated from a different material. For example, the cap and neck portions may be generally opaque, while the eye portion will be, of course, highly transparent.

It will be appreciated that the hood is omni-directional in its visual characteristics, thus permitting easy use of the apparatus in a panic situation.

Therefore, it is an object of the present invention to provide a protective hood apparatus which is fabricated from a gas impermeable flexible film of transparent heat resistant material, this film being coated with a film or deposition of an infra-red reflective metal which is applied to the entire outer surface of the enclosure.

It is yet a further object of the present invention to provide a protective hood enclosure for enveloping and otherwise covering a wearer's head, the enclosure being capable of withstanding substantial temperatures, and also capable of withstanding direct exposure to flame without igniting, fusing, or becoming molten.

It is still a further object of the present invention to provide a hood enclosure for covering and otherwise enclosing the wearer's head, the enclosure being provided with means for introducing breathing atmosphere to the environment enveloped, thus permitting the wearer to breathe normally without being overcome by noxious fumes, or suffocating from insufficient oxygen in the breathing atmosphere.

Other and further objects of the present invention will become apparent to those skilled in the art from a study of the accompanying drawing wherein:

FIG. 1 is a front perspective view showing one embodiment of the protective hood apparatus;

FIG. 2 is a view of an individual wearing the protective hood, wherein the protective hood covers and encloses the wearer's head;

FIG. 3 is a front perspective view, similar to FIG. 1, and illustrating a somewhat modified form of envelope structure having a rectangular configuration;

FIG. 4 is a sectional view taken through the plane of the film, and showing, on grossly enlarged scale, the various layers which comprise the enclosure environments;

FIG. 5 is a front perspective view showing a modified embodiment of the protective hood apparatus;

FIG. 6 is a vertical sectional view taken along the line and in the direction of the arrows 6—6 of FIG. 5 and being shown on an enlarged scale;

FIG. 7 is a front perspective view showing a further embodiment of the protective hood apparatus; and

FIG. 8 is a vertical sectional view taken along the line and in the direction of the arrows 8—8 of FIG. 7 and being shown on an enlarged scale.

In accordance with the preferred modification of the present invention, the protective hood enclosure generally designated 10 comprises an envelope or the like 11, the upper portion thereof being in the form of a hemisphere or the like, such as is shown at 12. The base of the hood enclosure may include, if desired, a drawstring or the like 13 threaded through various eyelets 14—14 disposed within the beaded area or zone 15. The end of the drawstring may be pulled, and tied together, particularly as shown in FIG. 2 of the drawing.

With particular attention being directed to FIG. 2, it will be observed that the hood enclosure 10 completely envelopes the head of the wearer, with the drawstrings 13 being closed around the wearer's neck in order to prevent the introduction of gaseous or other noxious fumes therein, the breathing supply member 20 being utilized to hold the confines of the hood 10 at a suitable modest super-pressure.

The envelope structure 11 is preferably prepared from a heat resistant flexible film material. One such material

is that certain polyimide (amide) substance sold under the code name Kapton by the E. I. du Pont de Nemours & Company of Wilmington, Del. This material is available in film form, such as a film having a cross-sectional thickness in the area of from 1 to 3 mils. Polyimide (amide) films of the polypyromellitimide type being capable of withstanding ambient temperatures in excess of about 1400° F.

In order to protect the outer surface of the flexible film, a coating of a visibly transparent infra-red reflective metal is applied to the entire outer surface of the enclosure. Visibly transparent films of aluminum, silver, gold or copper may be utilized. Film thicknesses of these various metals ranging from between about 200–400 Å. have been found useful, with specific films of aluminum generally being preferred below about 300 Å. It has been further found that somewhat heavier films of gold may be utilized, such as in the range of about 450 Å. Generally, aluminum ranging about 250 Å., silver ranging about 300–350 Å. have been found to be preferred. With particular attention being directed to FIG. 4 of the drawing, it can be seen that the plastic film shown at 11 is covered with a film of a metal such as aluminum at 16, this metallic film being covered with a second coating or film such as the thermal balance or protective film material 17. One particularly desirable thermal balance material is silicon monoxide, this providing a highly desirable A/E ratio, A referring to thermal absorption, E referring to thermal emission and further providing that radiation in the range of about 10 microns is absorbed. This material further provides protection against environmental conditions which may have an adverse affect on the metallic layer, such as those environments which would contribute to the formation of oxides or sulphides on the metal. In addition to retarding the optical transparent characteristics, sulphides or oxides of aluminum and silver are not as reflective to infra-red radiation as the pure metal. It will be further appreciated that the protective film assists in both storage capability and resistance to flame or other hazardous conditions present in catastrophic environments. While the preferred protective film material 17 is silicon monoxide, it will be appreciated that other materials such as magnesium fluoride, evaporated Teflon, or parylene may be utilized. The protective film further makes it possible to handle the materials by hand, since unprotected silver, for example, readily tarnishes upon exposure to the acids normally found in human perspiration.

When silicon monoxide is used as the protective film, a thickness of about 1000 Å. is generally preferable. This thickness is adequate to provide the protection, and this protection is then available without risking fracture or rupture of the film.

It will be appreciated that the structure of the protective hood should reasonably be capable of withstanding high ambient temperatures, and hence polypyromellitimide films are highly suited. In other situations, films of polycarbonates, or polyesters such as polyethylene terephthalate (Mylar) or films of polyvinylidene fluoride or other polymeric films may find utility.

In certain instances, it may be desirable to provide a source of atmosphere for the wearer. With attention being directed to the drawings, a canister, container, or the like 20 is provided which may carry a supply of air in compressed form. This device may be provided with a lid or seal which may be punctured in a variety of manners or ways, such as, for example, upon opening of a storage container, or upon opening of the base of the unit such as may be sensed by the drawstrings 13. In order to control the flow of the atmosphere, it may be desirable to provide a conduit for discharging the atmosphere at the top of the hood, and a porous metal or porous ceramic member may be utilized as a flow stabilizing device. This also would eliminate any jet effect from such an air supply.

With attention being directed to FIG. 3 of the drawing, it will be observed that the hood generally designated 10 is in the form of a rectangular envelope, as shown at 21. In contrast to the apparatus shown in FIG. 1, the top of the enclosure 21 is in the form of a flat enclosure which may be a gusseted fold member, or the like. In this instance, the member would be in the form of a tubular or sleeve element bonded at the closed top thereof. As an alternative, the envelope 21 may be formed of flat stock material, gusseted if necessary, and bonded along the edge surfaces as at 22 and 23.

Other puncturing techniques for an air supply may be made available, such as, for example, threaded actuators, lever arms on lanyards, or the like. Suitable sealing techniques may be utilized to control the flow of the atmosphere to a suitable discharge zone or point.

In one typical hood, the body being fabricated from a film of polypyromellitimide having a thickness of 2 mils, a film of silver having a thickness of 350 Å., and a coating of silicon monoxide of a thickness of 1000 Å. applied to the silver, the following data was obtained. The metalized surface was exposed to an ordinary infra-red heat lamp of 250 watts, and thermal couples were located on both sides of the film approximately $\frac{1}{16}$ inch from the film. Pyrometers were attached to the thermocouples and placed externally of the tested configuration in order to observe and record temperatures throughout the test. Readings were taken until the temperature reached a maximum level and remained constant.

TABLE I

Heat source	Distance from film, inches	Surface of film	Percent heat reflection
Infra-red lamp.....	6	Metalized silver....	69
Do.....	22	Film.....	15

In one typical exposure situation, human subjects were provided with hoods and exposed to an infrared heat lamp. One subject, wearing the hood metalized and provided with a protective coating as above, exhibited a skin temperature of 106° after an exposure of 10 minutes to such a lamp at a distance of only 6 inches. The same subject, when exposed to the same lamp at a distance of 22 inches, and utilizing a hood of polypyromellitimide without a metalized surface, experienced a skin temperature of 115° F. in a period of only 8 minutes.

With particular attention being directed to the embodiment shown in FIGS. 5 and 6, the hood 25 is fabricated in the same manner as that hood illustrated in FIG. 1, the exception being that the cap portion or segment 26 and the neck portion or segment 27 are each coated with a metalized film, as previously indicated. This metalized film is shown at 28 and 29 on FIG. 6. The segment or area normally covering the wearer's eyes as at 30, is free of any metalized coating or film. This feature enables the wearer to be better able to see in a smoky, dark environment. In a situation where flames are encountered, there is normally adequate light for vision, however in some smoky, dark environments, care should be taken to assure that the wearer's vision will not be unreasonably obscured.

In the embodiment shown in FIGS. 7 and 8, the hood generally designated 32 is provided with a cap portion 33 and a neck portion 34, along with a transparent visual segment or portion 35. Since the cap portion 33 and neck portion 34 are not generally utilized for vision of the wearer, these portions or segments of the hood may be fabricated from relatively less expensive, and generally more opaque materials. In order to prevent obscuring the vision of the wearer, the segment normally covered by the eyes, as at 35, will, of course, be fabricated from a material such as, for example, polypyromellitimide, as discussed heretofore. For example, the cap portion 33 and the neck portion 34 may be fabricated from a high temperature resistant silicone substance, such as a high temperature silicone rubber film. The metalizing is, of course,

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provided for the various segments of the hood, and this metalized film may or may not be applied over the portion normally covering the wearer's eyes.

It will be appreciated that in the modifications of FIGS. 5, 6, 7 and 8, the transparent portions covering the wearer's eyes extend, as shown, around the entire periphery of the hood. In other words, the portion 30 in FIGS. 5 and 6 extends around the entire periphery of the enclosure, while in FIGS. 7 and 8, the transparent portion 35 extends around the entire periphery of the enclosure.

It will be appreciated that individuals wearing these hoods may be able to move substantial distances through flame and smoke areas wearing these hoods, without suffering severely from the flame and smoke environment. In addition to aircraft and the like, these devices may find utility in other dangerous environments found in manufacturing facilities, refinery facilities and the like.

What is claimed is:

1. Protective hood means adapted to cover and enclose the wearer's head comprising:

(a) a hood enclosure adapted to cover and enclose the wearer's head, said hood enclosure having an open end, a closed end, and closure means on said open end to sealingly engage the neck of the wearer, and being fabricated from a gas impermeable flexible film of transparent heat resistant material, the hood enclosure including an upper cap portion and a depending tubular face covering portion of substantially uniform construction about the circumference at any individual axial disposition, and

(b) a visibly transparent thin film of an infra-red reflective metal applied to the outer surfaces of said enclosure.

2. The protective hood means as defined in claim 1 being particularly characterized in that a visibly transparent protective heat resistant film is applied to the outer exposed surface of said reflective metal film.

3. The protective hood means as defined in claim 2 being particularly characterized in that said infra-red reflective metal is selected from the group consisting of aluminum, silver, gold, and copper.

4. The protective hood means as defined in claim 2 being particularly characterized in that said protective heat resistant film is selected from the group consisting of silicon monoxide and magnesium fluoride.

5. Protective hood means adapted to cover and enclose the wearer's head comprising:

(a) a hood enclosure adapted to cover and enclose the wearer's head, said hood having an open end, a closed end, and a closure means on said open end adapted to sealingly engage the neck of the wearer, and being fabricated from a gas impermeable flexible film of transparent heat resistant material, the hood enclosure including an upper cap portion and a depending tubular face covering portion,

(b) a visibly transparent thin film of an infra-red reflective metal applied to the outer surfaces of said enclosure, and

(c) means connected to the hood for providing a breathing atmosphere for the wearer within the confines of said protective hood.

6. Protective hood means adapted to cover and enclose the wearer's head comprising:

(a) a hood enclosure having an open end, a closed end, and a closure means on the open end adapted

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to sealingly engage the neck of the wearer, and including a cap portion, a tubular neck portion, and an intermediately disposed tubular eye covering portion, the hood enclosure being adapted for covering and enclosing the wearer's head, and being fabricated from a gas impermeable flexible heat resistant material, at least the entire eye covering portion of which is highly transparent, and

(b) a visibly transparent thin film of an infra-red reflective metal applied to substantially the entire outer surface of said enclosure.

7. The protective hood means as defined in claim 6 being particularly characterized in that

(a) said visibly transparent thin film of infra-red reflective metal is applied to the entire surface of said cap and neck portions.

8. The protective hood means as defined in claim 6 being particularly characterized in that means are connected to the hood to provide a breathing atmosphere for the wearer within the confines of said protective hood.

9. The protective hood means as defined in claim 6 being particularly characterized in that said infra-red reflective metal is selected from the group consisting of aluminum, silver, gold, and copper.

10. The protective hood means as defined in claim 6 being particularly characterized in that said protective heat resistant film is selected from the group consisting of silicon monoxide and magnesium fluoride.

11. The protective hood means as defined in claim 6 being particularly characterized in that the flexible heat resistant material of which the hood enclosure is fabricated is polypyromellitimide.

12. The protective hood means as defined in claim 11 being particularly characterized in that said polypyromellitimide film has a thickness of about 2 mils.

13. The protective hood means as defined in claim 11 being particularly characterized in that said infra-red reflective metal is selected from the group consisting of aluminum, silver, gold, and copper.

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RICHARD A. GAUDET, Primary Examiner

KYLE L. HOWELL, Assistant Examiner

U.S. Cl. X.R.

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