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PROTECTIVE GARMENT FOR ASTRONAUTS EMPLOYING SUBLIMATING SALTS

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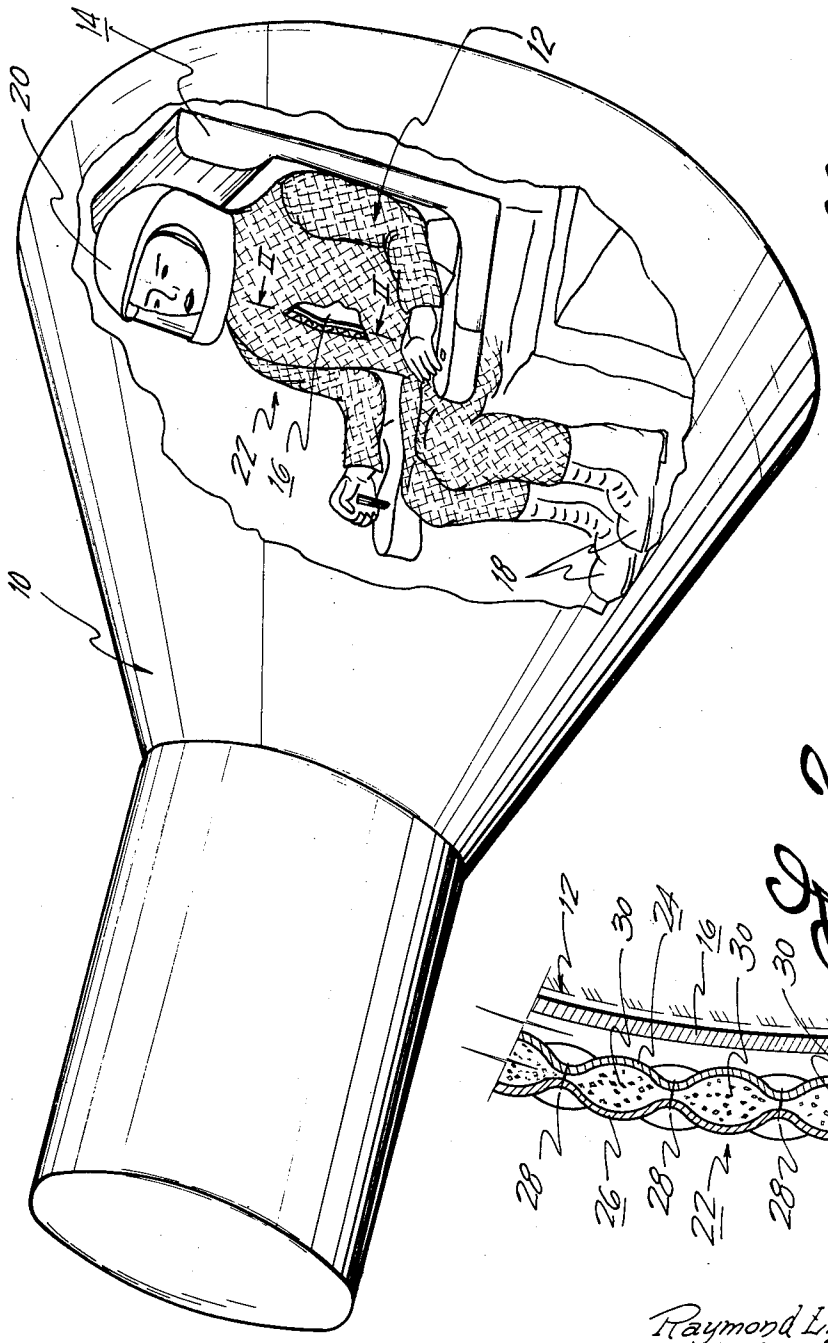


Fig. 1

Fig. 2

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PROTECTIVE GARMENT FOR ASTRONAUTS EMPLOYING SUBLIMATING SALTS

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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.

This invention relates to heat protective garments and more particularly to heat protective garments that are particularly well adapted to be worn by the occupants of space vehicles or the like.

One object of the invention is to increase the protection afforded by a heat protective garment.

Another object of the invention is to protect the occupant of a space vehicle against excessive heat.

In conformity with these objects, the present invention contemplates a heat protective garment or suit which employs a sublimating material or subliminating composition as a means to protect the wearer of the garment against excessive heat. The sublimating material is preferably incorporated into the body of the garment although it may be applied to both the inner and outer surfaces thereof. A heat protective garment embodying the present invention significantly improves prior art garments or suits in that it not only protects the wearer of the garment against reflected heat but also affords protection against conducted and convected heat.

The aforementioned and other objects of the present invention will become readily apparent to those skilled in the art from the following detailed description of one specific embodiment thereof taken in connection with the accompanying drawings, wherein:

FIG. 1 is a perspective view of an occupant of a space vehicle wearing the heat protective garment of the present invention; and

FIG. 2 is a section taken along the line II—II of FIG. 1.

Referring particularly to the drawings, there is shown in FIG. 1 a space vehicle or the like **10** in which is seated an occupant or passenger **12**, the occupant or passenger **12** in this specific illustration of the invention taking the form of a human being. The occupant **12** is seated within a seat **14** designed and constructed to protect the occupant **12** from the harmful effects of high acceleration or gravity loads. Occupant **12** wears or is protected by a pressurized flying suit **16** including boots **18** and a helmet **20**, and the pressurized flying suit **16**, as is well known, is adapted to be supplied with oxygen for breathing purposes as well as ventilation air under a predetermined pressure from a suitable source within the vehicle (not shown) to cool the body of occupant **12**.

To protect the occupant **12** against excessive heat within the space vehicle **10**, such as when the vehicle is leaving or entering the earth's atmosphere, occupant **12** also wears or is protected by the heat protective garment or suit **22** of the present invention. Heat protective garment **22** is adapted to be worn as an outer garment over the pressurized suit **16** and, in construction, is comprised of a plurality of interconnected layers of cloth or fabric between which is carried a sublimating means or sublimating material to absorb heat. The cloth may be made of any natural or synthetic fiber suitable of use in making garments, and the sublimating means preferably assumes the form of a sublimating salt, although it will be apparent that a sublimating means in any other form capable of being carried between a plurality of layers of cloth could be successfully employed.

In this one specific embodiment of the invention, as best shown in FIG. 2, the garment **22** takes the form of an inner layer of cloth **24** and an outer layer of cloth **26** which are connected at spaced points by a plurality of stitches **28**. Inner and outer layers of cloth **24** and **26** are made of nylon in this specific instance and stitches **28**, also made of nylon, are arranged in a predetermined line or pattern (FIG. 1) to thus yield a quilting arrangement or quilt. This quilting arrangement or quilted connection between the layers of cloth **24** and **26** defines a plurality of pockets or envelopes in garment **22** which are adapted to carry or receive a sublimating salt **30**, the pockets or envelopes thus holding the salt **30** in a predetermined position between the layers of cloth and insuring a substantially uniform distribution of salt throughout the garment.

In this one specific embodiment of the invention, the sublimating salt **30** takes the form of alpha-chloro-anthraquinone or chloro-anthraquinone (1), although it will be appreciated that other sublimating salts possessing similar function characteristics and physical properties could be successfully employed. Some other sublimating salts which have been found to perform satisfactorily are alpha-hydroxy-anthraquinone, methyl-anthraquinone, dichloroquinone and dichlorohydroquinone. Chloro-anthraquinone (1) is especially desirable for use as the sublimating material in garment **22** inasmuch as it will not decompose at its melting point (162° C.) and will continue to sublime at and above the melting point at substantially the same rate. Chloro-anthraquinone (1) has been found to be further advantageous in that there is no evidence that it is toxic either as a salt or as a vapor, i.e., will not irritate or produce a rash or itch on human skin.

The thickness of suit **22** will, of course, be determined for the most part by the amount of sublimating salt **30** that is carried between the layers of cloth **24** and **26** which in turn will be determined mainly by the temperature and pressure conditions under which the suit **22** is expected to function or operate. During extremely high temperature and low pressure operating conditions, such as when the space vehicle **10** is either leaving or entering the earth's atmosphere, it will of course be advantageous to employ as much of the sublimating salt as possible. The sublimating salt **30** will protect the occupant **12** from the excessive heat under these operating conditions, i.e., heat not capable of being absorbed by the ventilation air in suit **16**, by absorbing the heat that surrounds the garment **22**, the sublimating salt **30** in this instance having a relatively large heat absorption capacity. This excessive heat will be absorbed through the sublimation of salt **30**, and salt **30** will, of course, continuously diminish in quantity during any given high temperature and low pressure or high temperature flight condition.

Although not shown in the drawings, the present invention also contemplates the idea of coating the inner and outer surfaces of a heat protective garment with a sublimating salt to effect a further absorption of heat. This sublimating salt coating could be employed in combination with the salt carried between the cloth layers of the suit or could be employed in the absence of a salt barrier between the cloth layers of the suit. The use or non-use of a salt coating in any given circumstance will be a matter of choice and will be determined for the most part by the particular materials being employed in the construction of the garment and the particular temperature and pressure conditions under which the garment is expected to operate.

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 appended claim the invention may be practiced otherwise than as specifically described.

What is claimed is:

A heat protective garment adapted to be worn by the occupant of a space vehicle or the like comprising layers of cloth; a sublimating material carried between said layers of cloth; and means connecting said layers of cloth forming a plurality of enclosures therein for holding said sublimating material, wherein said sublimating material takes the form of a sublimating salt, the sublimating salt being one selected from the group consisting of chloro-anthraquinone (1), hydroxy-anthraquinone (1), methyl-anthraquinone, dichloroquinone and dichlorohydroquinone.

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