Dec. 26, 1967 C. J. ZEMME ETAL 3,359,567

PROTECTIVE SUIT

Filed Dec. 13, 1965 2 Sheets-Sheet 1

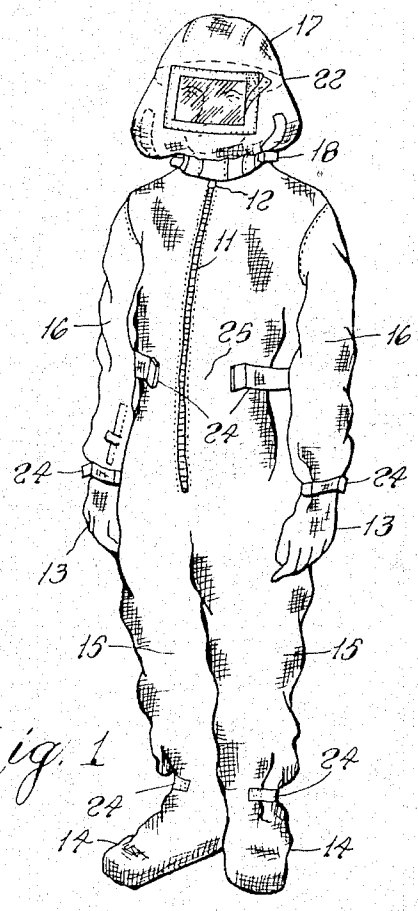

Fig. 1

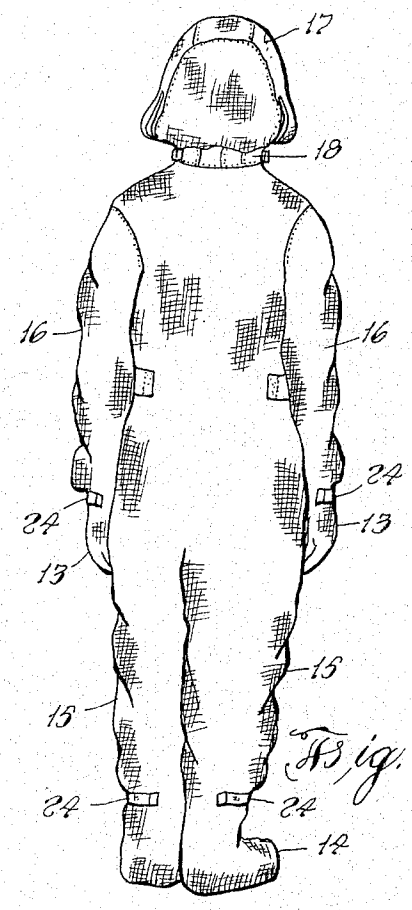

Fig. 2

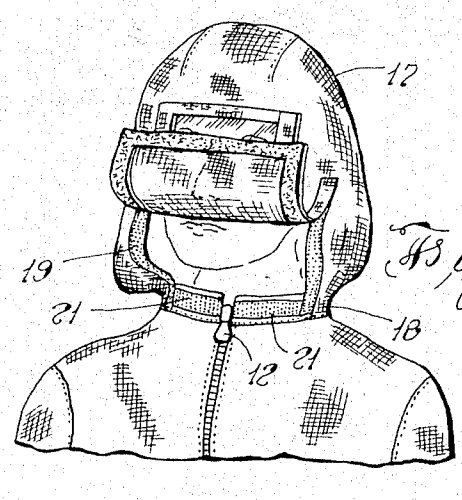

Fig. 3

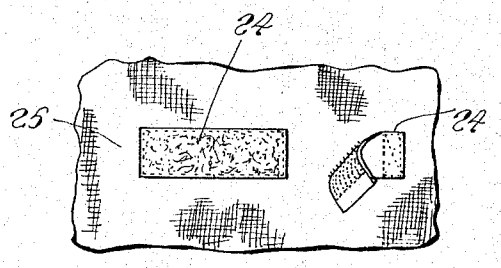

Fig. 6

INVENTORS.
CAESAR J. ZEMME
BENJAMIN S. DEFAZIO
LIONEL I. WEINSTOCK
BY
Edward P. Costigan
Lon B. Eggleston
ATTORNEYS

Dec. 26, 1967 C. J. ZEMME ETAL 3,359,567

PROTECTIVE SUIT

Filed Dec. 13, 1965 2 Sheets-Sheet 2

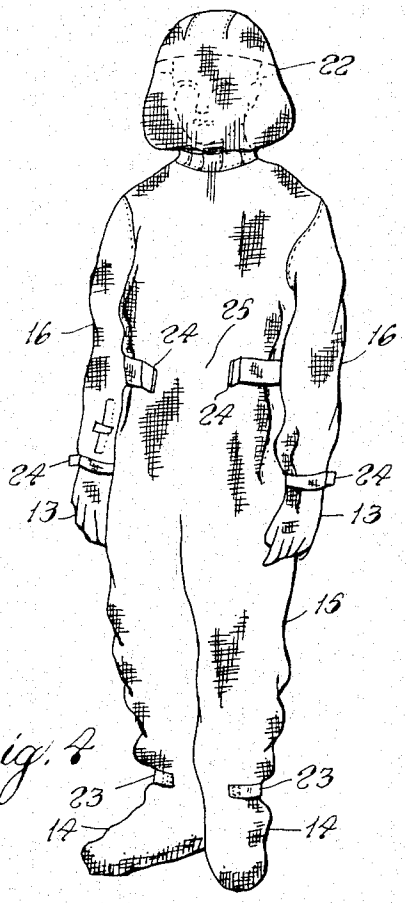

Fig. 4

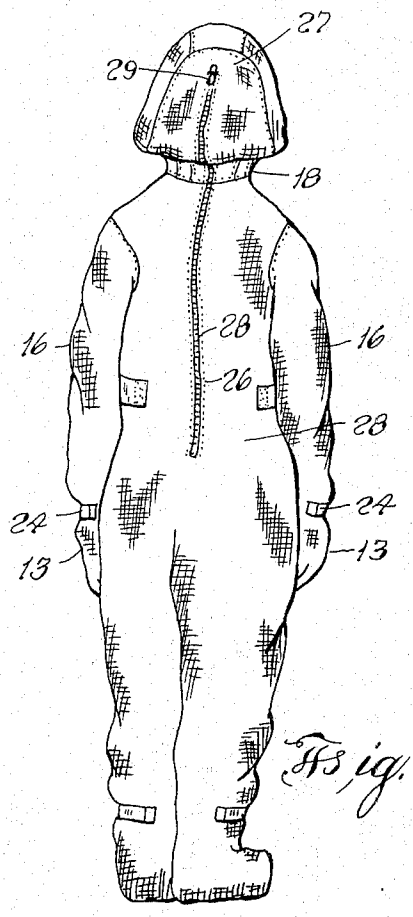

Fig. 5

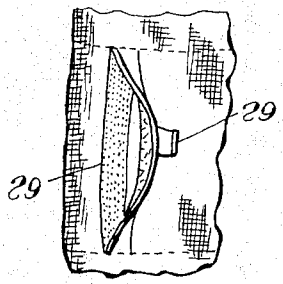

Fig. 7

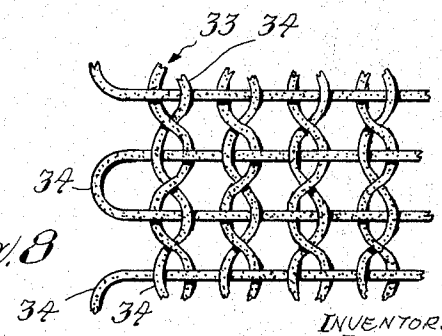

Fig. 8

INVENTORS.
CAESAR J. ZEMME
BENJAMIN S. DEFAZIO
LIONEL I WEINSTOCK

BY Edward F. Costigan
Lon B. Eggleston
ATTORNEYS

United States Patent Office 3,359,567
Patented Dec. 26, 1967

3,359,567

PROTECTIVE SUIT

Caesar J. Zemme, New York, Benjamin S. De Fazio, Westbury, and Lionel I. Weinstock, Rockaway Park, N.Y., assignors to the United States of America as represented by the Secretary of the Navy

Filed Dec. 13, 1965, Ser. No. 513,910
4 Claims. (Cl. 2—2)

ABSTRACT OF THE DISCLOSURE

A suit for protecting the wearer from the damaging effects of high-powered radio-frequency waves is provided, the suit in its entirety being made of a single layer of an open mesh fabric made from metallized nylon fiber. Metallizing is accomplished by affixing metal particles to the nylon fiber. The hood is made of the same material as the remainder of the suit and may or may not include a visor, the open mesh providing unrestricted vision as well as substantially unrestricted ventilation for the wearer.

This invention relates to an environmental protection suit for use by radar personnel. More particularly, this invention relates to a suit for use in protecting personnel against the damaging effects of high-powered radio-frequency waves.

It is known that a field of high-powered radio-frequency waves may adversely affect the human body. All of the observed harmful biological effects indicate that the body of a person requires protection if he is to safely work in such an environment.

Suits of the type hereinafter described have been in use for the protection of personnel servicing and maintaining the radar equipment of the early warning system. However, it has been found that such suits are extremely bulky, clumsy, and heavy.

Garments of the above type are usually of a coverall design with attached hood, gloves and boots. In the past, such suits have been fabricated of four layers of material including an outer waterproof neoprene-coated nylon fabric, two layers of silverized nylon interlining, and an inner cotton or rayon lining fabric. These suits are rubberized and waterproof, and very uncomfortable to wear, even in cold weather, and impose a high heat stress in warm environment. It is quite apparent that these suits were designed for short periods of use in cold weather as required at outlying early warning sites.

It has been found, however, that the above suits are not considered suitable for use on shipboard, due to the requirement that such suits must be worn for extended watch periods in all types of weather while performing shipboard duties. Also, such suits are not considered safe for tasks requiring climbing or movement at high altitudes or in tight, confined quarters because of their bulk, weight, and poor foot and hand dexterity. As a further disadvantage, such suits have been found to be quite costly.

It is an object of this invention to provide an inexpensive, lightweight protection suit affording improved hand and foot dexterity for use by personnel who are exposed to an electromagnetic field of very high frequency.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a front view of a protective suit, showing a preferred embodiment of this invention;

FIG. 2 is a back view of the suit shown in FIG. 1;

FIG. 3 is a detailed view of the hood of the suit shown in FIG. 1;

FIG. 4 is a further embodiment of the suit of this invention;

FIG. 5 is a back view of the suit shown in FIG. 4;

FIG. 6 is a view of a waist adjustment structure;

FIG. 7 is a view of an arm opening construction;

FIG. 8 is an enlarged fragmentary view of the fabric of the suit.

Similar numerals refer to similar parts throughout the several views.

We have invented an inexpensive, lightweight protection suit made from silverized nylon marquisette fabric to shield against microwave radiation. The fabric is lightweight, yet strong, and extremely porous and flexible. It can be easily fabricated into garments with simple double or single needle type seams. A single layer only is required and commercial-type cotton or nylon sewing threads can be used.

The suit, as shown in FIGS. 1 and 2, is a coverall type garment with a front opening **11** secured by a slide fastener **12**. The gloves **13** and foot coverings **14** are also permanently attached to the garment. The sleeve **16** are of the wing type variety having dropped armholes.

The suit may be donned by the wearer by stepping into the trouser legs **15** and then inserting the arms in the sleeves **16**. After the front zipper **12** is closed, the hood **17**, which is permanently attached to the back half of the neckline **18**, is placed over the head. The hood **17**, as shown in FIG. 3, is then secured by first closing the side Velcro closures **19** and then closing the front neck portion of the Velcro closure **21** over the front collar portion.

The hood **17** is worn over a hard hat **22** or bump cap for shape retention and head protection. The hat keeps the hood fabric away from the face and allows full head mobility, while maintaining good visibility by virtue of the open mesh fabric used. The semi-detachable hood **17** can be taken off, when not required, by opening the front Velcro closures **19** and **21** and letting the whole hood **17** fall back over the shoulders.

Another embodiment of the protective suit is shown in FIGS. 4 and 5. As shown, ingress is accomplished through the opening **26** in the back half of the suit. This opening traverses the area between the upper portion **27** of the back of the head and the small of the back. The opening is provided with interlocking teeth **28** engaged by means of a zipper **29** which maintains full conductivity with each side panel of cloth. One advantage of this type suit is the visor which is fabricated from the same type of material as the suit itself. This material, which is hereinafter described in detail, enables a full field of vision by virtue of the open mesh fabric when the hood is worn over the head. It also provides sufficient protection for the eyes against the damaging effects of the high frequency electromagnetic waves.

Silverized nylon, Velcro type tape fasteners **21** are located on each side of the hood in the suit shown in FIGS. 1 and 3 and are used to attach the front half of the hood to the front collar portion of the neckline of the suit. These metallized tape closures are fully conductive and maintain both attenuation and electrical continuity between adjacent cloth panels.

Non-conductive Velcro type closures **24**, as shown in FIG. 6, are used at the waistline **25** as side body adjustments, as well as for wrist and ankle adjustment.

Conductive Velcro type fasteners **29** are also used to close the hand openings provided under each sleeve **16**. The opening, as shown in FIG. 7, is provided to enable the hands to be freed from the garment whenever required without the necessity of removing the garment.

The base material 33 used throughout each of the garments is a nylon marquisette fabric, as shown in FIG. 8, which is metallized with silver 34 to provide the necessary attenuation in the frequency ranges utilized. The suit is electrically conductive throughout. The warp yarns as shown are single-ply 260 denier, 17 filament nylon and the filling yarns are 2 ply, 260 denier, 17 filament nylon. The weave is a plain doupe leno type designed to give approximately 1 mm. square openings between the warp and filling yarn interlacings. By the use of a single layer of strong, lightweight, open mesh base material, a very comfortable, flexible garment has been designed. It is capable of being worn in combination with a wide range of under and outer garments, depending on existing environmental weather and work conditions. It will afford and maintain complete and effective shielding of the body against microwaves, regardless of what outer garments are used. When worn in hot, dry weather, only a lightweight shirt and trousers are required as outer clothing primarily to prevent arc-over. Wet weather raingear or cold weather clothing can be used when required. Rubber or plastic gloves and boots are also used to prevent arc-over and to increase service-life.

All main side, sleeve and shoulder seams are of the double-needle type. All others, including hood, hand, and feet attachments, are single needle, turned-top stitched seams. All seams maintain electrical continuity between adjacent cloth sections and preserve the necessary shielding effectiveness.

Obviously, there are many modifications and variations which are possible in view of the above teaching. It is therefore to be understood that these modifications and variations are to be included within the scope of the appended claims.

We claim:

1. A lightweight protective suit completely encompassing the body to provide protection against radio-frequency waves and adapted to be worn under a variety of foul weather or other overgarments comprising:

a body portion made of a single layer of permeable conductive material;

said material having an open mesh adapted to permit substantially unrestricated ventilation therethrough;

said material formed of a non-metallic fiber metallized by affixing metal particles to the surface thereof;

a hood portion made of said material and adapted for releasable attachment to said body portion;

electrically conductive means separably connecting said hood portion and said body portion; and

wearer ingress and egress means in said suit;

said ingress and egress means electrically conductive when closed;

the open mesh of said material permitting unrestricted vision therethrough of the wearer.

2. The suit as defined in claim 1 wherein said ingress and egress means is a zipper disposed at the rear of the suit and extending from at least the neck of the body portion to a point substantially below the waist thereof.

3. The suit as defined in claim 2 and further including electrically conductive visor means in said hood;

said visor means adapted to be readily opened and closed as desired by the wearer.

4. The suit as defined in claim 3 wherein said fiber is nylon and said metal particles are silver.

References Cited

UNITED STATES PATENTS

2,344,811	3/1944	Gill	2—2
2,807,287	9/1957	Frey	139—419
3,164,840	1/1965	Reynolds	2—2
3,196,459	7/1965	Grazia	2—2

HENRY S. JAUDON, *Primary Examiner.*