CLOTHING TO PROTECT THE ENVIRONMENT FROM CONTAMINATION

12 Claims, 5 Drawing Figs.

ABSTRACT: An article of protective clothing for protecting, for example, an environment from contamination by a wearer. The clothing comprises a gown cooperating with a face mask which has a suction line connected thereto to enable contaminated air to be drawn out through such suction pipe instead of escaping into the environment.
Fig. 4.

Fig. 5.
1 CLOTHING TO PROTECT THE ENVIRONMENT FROM CONTAMINATION

BACKGROUND OF THE INVENTION

1. Field of the Invention
This invention concerns an article of protective clothing for example, for protecting an environment from contamination by a wearer, and suitable for use in preventing the emanation into the surrounding atmosphere of dust or epidermal scales from the underclothing and body of a wearer of the clothing when such wearer is required to enter and work in a sterile or dust-free environment such as, for example, a surgical operating theatre, a microbiological laboratory or factory, a food processing factory or the like.

2. The Prior Art
It has been only recently recognised that the main source of air-borne bacteria in surgical operating theatres emanates as much from the surface of the human body, in the form of epidermal scales carrying bacteria, as from the more generally recognised source of the nose and mouth. Air entering a surgical operating theatre from a modern ventilating plant is almost sterile (approximately 0.1 colonly per cubic foot) whereas the ambient air in the theatre may contain approximately 5.0 colonly per cubic foot as a result of contamination from personnel in the operating theatre. The same contamination figures quoted above are also applicable to industrial processes where workers have to share the same air as the product being manufactured.

One method of reducing the bacterial content of the air in such an environment is to increase the flow of filtered air through the theatre, chamber or factory, but it has been shown that to approach very sterile conditions by this means (i.e. to counteract the rate of emanation of contaminated particles from the operative or workers) would require at least 200 air changes of the whole theatre, chamber or factory per hour. This would be prohibitively expensive in electric power, maintenance of filters and the cost of the ventilation plant, and in the end this ventilation system would still not achieve complete sterility of the air in the ventilated working space.

The only way to achieve a very high degree of air cleanliness, without entailing enormous costs, is by combining an economically reasonable number of air changes per hour in the working space with clothing with the operatives or workers, such clothing being provided with means for extracting the bacteria or dust-laden air emanating from the body or underclothing of the operatives or workers.

Prior to the invention, attempts to use the idea of extracting contaminated air from the body "at source" especially in surgical operating theatres, have been based on air-tight clothing which has been developed from space-suits worn by astronauts and which totally encloses the wearer. However, the disadvantages of such space-suit type clothing are very numerous. For example, the clothing is very expensive and for personal reasons and to maintain hygiene each operative would need his own clothing or suit. The clothing is clumsy and takes time and assistance to put on and take off. After being used only a few times the clothing becomes a potential infection-bearing source both inside and outside. It is impossible to provide a sterilised suit of this type for every occasion as in a surgical operating theatre each operative in the surgical team might need up to six suits per day. The suit could be covered with a sterile gown but no advantage is gained by this since the contaminated suit underneath would be no cleaner than the ordinary outside clothes of the wearer.

Ideally such space-suit type clothing would have to be designed to work with the interior below atmospheric pressure so that in the event of a puncture occurring in the clothing air would be drawn into the clothing from the surrounding atmosphere instead of releasing contaminated air from the interior of the clothing. Maintaining the air pressure inside the clothing below atmospheric pressure while obtaining an even flow of air over the body of the wearer without the clothing collapsing onto the wearer's body due to the reduced internal pressure, presents great practical difficulties. The porous "spacer" linings needed to permit this flow of air have proved, in practical tests, to be hot and inefficient.

It is an object of the invention to obviate the aforementioned disadvantages.

SUMMARY OF THE INVENTION

The present invention provides an article of protective clothing comprising a sleeved gown including an integrally formed hood having a front opening therein, a face mask positioned in said front opening, said face mask having a viewing aperture, connection means provided on said mask and connecting with the interior of said mask, and a suction line connected to said connection means.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary front elevation of an embodiment of the protective clothing of the invention in position on a wearer;

FIG. 2 is a side elevation corresponding to FIG. 1;

FIG. 3 is an enlarged perspective view of the mask and sleeve lines shown in FIG. 1 and 2;

FIG. 4 is an enlarged cross-section of the mask shown in FIG. 3 in position on the wearer's head; and

FIG. 5 is a cross-section taken along the line V-V in FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The drawings show an embodiment of an article of protective clothing, for preventing the emanation into the surrounding atmosphere of dust or epidermal scales from the under clothing or body of a wearer of the clothing, conforming to the invention and comprising a sleeved gown 10 and a face mask 11. The gown is formed with an integral hood 12 which has a wide neck 13 and also includes an oval shaped front opening 14 therein. The front opening 14 is provided with a purse-string 15 which extends around the periphery of the opening in an appropriate tunnel hem 16. The gown 10, which is of a material impermeable to bacteria, dust particles or epidermal scales or the like, (such as a close woven cotton fabric), has an open bottom end or skirt (not shown) and is adapted so that such bottom end just reaches the floor or ground when the gown 10 is worn by a wearer 17. Each sleeve 18 of the gown is provided with elasticated cuffs 19.

The face mask 11 comprises an arcuate plastics face plate 20 which is generally rectangular when viewed in front elevation. The face piece 20 is stepped to provide a mounting flange 21 for a detachable rectangular transparent Perspex (registered trademark) window 22 of the mask 11. The window 22 is provided with three ventilating inlet apertures 23 spaced near to its bottom edge. The face piece 20 also includes an inverted L-sectioned arcuate plastics member 24, the upright of such member 24 being connected so as to be up-standing from a lower flange 25 of the piece 20 with the free end of the member abutting the window 22. Such member 24 has an arcuate intake 26 at the joining of its two limbs. At respective locations adjacent each end of the member 24, the member 24 and the adjacent outer part of the face piece 20 are shaped to provide generally circular sectioned connections 27 for accommodating respective flexible suction pipes 28, are connected by a three-armed junction tube 29 to a further suction pipe 30.

The top rim 31 of the face piece 20 is provided with a flexible pad 32, for engaging the forehead of the wearer 17. A transverse locating strap 33 is attached to the face piece 20 adjacent each end of the pad 32, by a respective rivet 34. The free ends of the strap 33 are adjustable connected together by a lace 35 extending through eyes 36 in the straps 33. Two supporting straps 37 are connected to and extend from the upper edge of each of the straps 33, the ends of each of the straps 37 remote from the straps 33 being provided with
a respective tunnel 38 through which a further adjusting lace 39 extends. The positions of the straps 33 and 37 are adjustable by means of the respective laces 35 and 39 so that the wearer 17 can place the mask 11 comfortably on his head with the pad 32 abutting his forehead and the straps 33, 37 extending around the contours of his head (see Fig. 4).

The end of the further suction pipe 30 remote from the junction tube 29 is provided with a connector (not shown) which is adapted to co-operate with a respective one of a plurality of suction connections (not shown) in the form of self-sealing valves to close the connections when they are not in use. The suction connections are connected by a system of suction manifolds to a main vacuum pipe which leads to one or more extractor fans.

The use of the protective clothing of the invention will now be described with particular reference to its use in a surgical operating theatre.

The face mask 11 is first donned by the wearer 17 and the straps 33, 37 of the mask 11 adjusted by means of the laces 35, 39 so that the face piece 20 comfortably covers the wearer's face with the pad 32 abutting the wearer's forehead. In this position, the suction pipes 28 held by their respective connections 27, can draw air from the area of the wearer's nose and mouth through the arcuate intake 26.

A junction tube 29 (not shown) connected to the junction tube 29, can then be placed around the wearer's neck to take the weight of the further suction pipe 30 off the mask 11. In order to hold the junction tube 29 against any lateral pull from the further suction pipe 30 such further suction pipe 30 can be provided with a clip (not shown) which is attached to the midline or waistbelt of the wearer's underclothing.

The gown 10 may then be donned by the wearer 17 by pulling the open bottom end over his head like a night-shirt, to avoid any opening of the gown 10 down the back as is customary in surgical gowns. While drawing the gown over his head the wearer simultaneously feeds his arms into the respective sleeves 18 of the gown. This operation is continued until the hood 12 envelopes and leaves generally triangular shaped across at each side of the wearer's head. The front opening 14 in the hood 12 may then be adjusted so that when the purse string 15 is pulled tight, the periphery of the front opening 14 is pulled tight against the mounting flange 21. The wearer 17 then dons the usual plastic gloves worn in an operating theatre, such gloves extending over the elasticated cuffs 19 of the sleeves 18 of the gown 10.

The wearer 17 may then enter a surgical operating theatre. The end of the further suction pipe 30 which is provided with the connector is then attached to a desired one of the suction connections provided in the suction manifolds disposed on the floor of the operating theatre.

The extractor fan or fans are then switched on and air is thereby drawn from the region of the eyes nose and mouth of the wearer 17, through the suction pipes 28, 30 and the suction manifolds to the extractor fan or fans which are disposed outside the theatre.

It will thus be appreciated that any contaminated air rising from the surface of the wearer's body or his underclothes will rise into the hood 12, as the hood 12 has the generally triangular shaped spaces and is not constricted around its neck, and be drawn out through the suction pipes 28, 30. Thus, the wearer's body, which otherwise would become too hot owing to the substantial non-permeability of the gown to air is cooled by the flow of air induced thereover.

The depression of air pressure in the hood 12 of the gown 10, caused by the suction pipes 28, 30 has the following important results. Firstly, it accelerates the ascending current of hot and contaminated air in the gown 10 which originally entered at the lower open end of the gown 10 thus reducing the chance of contaminated air passing out of the lower end of the gown 10. Secondly, spectacles may be worn as the mask 11 does not fit the face with a hermetic seal and the air current caused by the suction lines prevents spectacles becoming steamed up with condensation.

Conversation with adjacent workers is facilitated in a way not possible with a completely sealed helmet.

The invention is not confined to the precise details of the foregoing example and variations may be made thereeto.

For example, the suction line need not be branched and may simply be attached directly to the mask 11. Also, the gown does not need to be of close woven cotton fabric and could be of a plastics or paper. Generally speaking, a fabric which is impermeable to bacteria and dust and the like and which is repeatedly autoclaved would probably be most commonly used, though a disposable paper or plastic gown could be used.

Instead of the purse-string 15, tapes could be attached to opposite ends of the hem 16 such tapes being adapted to be tied around the wearer's head to the hem 16 against the face mask 11. It is an important feature of the design of the clothing that the window 22 is detachable from the face mask 11. To facilitate replacement of the window 22, four "joggles" may be provided on the edge of the rectangular front aperture in the mask 11, one joggle on each side of the aperture. Thus, when a window 22 is being removed from or inserted into the aperture in the face mask 11, such window 22 may be slid easily through the joggles. It would thus be possible for the transparent window 22 to be changed by an assistant if visibility became impaired, for example, blood splashing onto the front of the window during the course of a surgical operation. By virtue of the window being readily detachable and disposable, it should always be possible to start each operation or procedure with a new window instead of having to use old windows which might have become scratched or otherwise impaired due to cleaning.

The leakage of air around the edges of the transparent window is of no importance since it merely encourages more air to be sucked past the wearer's face for the purpose of refreshment. The main source of this refreshing air is sucked through the ventilating apertures 23 in the window 22.

It is not necessary for the front of the face mask 11 to be closed by the detachable window 22 and such window may be adapted to extend over, for example, the lower half or lower two-thirds of the rectangular front aperture of the mask 11.

The size of the resultant aperture left open at the front of the mask will be directly proportional to the rate at which air is sucked out through the suction pipes 28, so that there is always a persistent inward air-flow through the aperture. Thus, it will be appreciated that if a high enough suction rate is used the front of the mask may be left completely open. By using the mask with a completely or partially open face mask, the working conditions of the wearer can be rendered rather more pleasant than in the mask with the closed front, and conversation with adjacent workers is particularly facilitated.

Though the gown 10 described in the above embodiment is shaped like a nightshirt to be put on over the head of the wearer, the gown 10 may have a rear opening to facilitate application of the gown 10, such opening being adapted to be sealed closed when the gown is in use.

Instead of the mask 11 being adapted to be supported on the wearer's head by the straps 33, 37 with the pad 32 in contact with the wearer's head it is possible for the mask to be adapted to be held against the wearer's face, without the straps 33, 37 in the manner of goggles or an underwater swimming mask.

The face mask 11 need not necessarily be of a plastics material and could for example, be of metal or rubber. Also the face mask 11 may be adapted to surround the wearer's eyes and nose or only the wearer's eyes.

Use of the protective clothing of the invention is not limited to surgical operating theatres and it can be used anywhere it is desired to have a sterile or dust-free atmosphere.

I claim:

1. An article of protective clothing comprising: a sleeved gown including an integrally formed hood having a front opening therein, a face mask positioned in front of the face opening and having a viewing aperture, connection means provided on the face mask and connecting with the interior of the face mask, a suction line connected to the connection means, the face...
mask including a face piece generally rectangular in front elevation and comprising a stepped mounting flange extending around the periphery of the viewing aperture, a transparent window supported by the stepped mounting flange, and an inverted L-sectioned member having an intake therein, the connection means comprising respective connections at each end of the inverted L-sectioned member.

2. The article of protective clothing as set forth in claim 1 and further including, a junction tube connected to one end of the suction line, and two secondary suction lines, each one of the secondary suction lines connected between a respective one of the connections and the junction tube.

3. The article of protective clothing as set forth in claim 2, the suction line and secondary suction lines each comprising a respective flexible pipe.

4. The article of protective clothing as set forth in claim 1 having a tunnel hem extending around the periphery of the front opening, and a purse-string slidably accommodated in the tunnel hem and removably securing the face mask in the front opening.

5. The article of protective clothing as set forth in claim 1 and further including a transparent window located in the viewing aperture.

6. The article of protective clothing as set forth in claim 1, the face mask being shaped to surround at least the eyes of a wearer.

7. The article of protective clothing as set forth in claim 5, the transparent window being removable.

8. The article of protective clothing as set forth in claim 7 and further including intake apertures in the transparent window.

9. The article of protective clothing as set forth in claim 1, the face mask comprising a head harness including a plurality of straps for locating the face mask on a wearer's head, and a pad located on the face mask for abutting a wearer's forehead.

10. The article of protective clothing as set forth in claim 1, the gown comprising an open bottom end and adapted so that the bottom end just touches the ground when the gown is worn.

11. The article of protective clothing as set forth in claim 1, the hood being generally triangular in front elevation to facilitate evacuation of the gown through the suction line.

12. The article of protective clothing as set forth in claim 1, the gown comprising a rear opening to facilitate application thereof to a wearer sealing means permitting closing of the rear opening and an elasticated cuff at the end of each sleeve of the gown.