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3,719,136

METHOD AND MEANS FOR PROVIDING A CLEAN AREA

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2 Sheets-Sheet 1

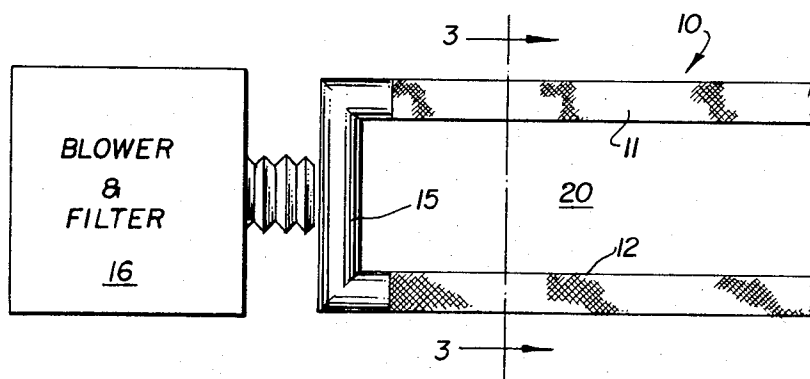


FIG. 1.



FIG. 2.

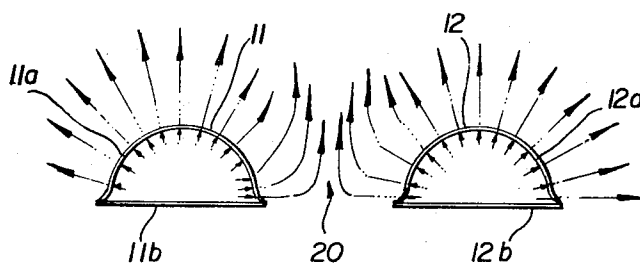


FIG. 3.

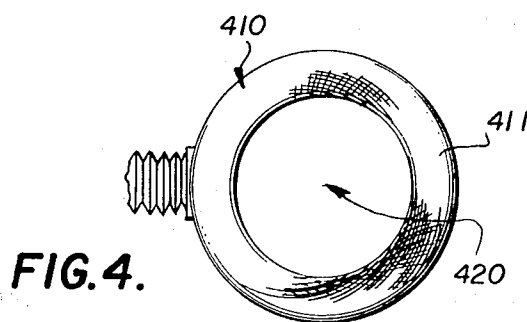


FIG. 4.

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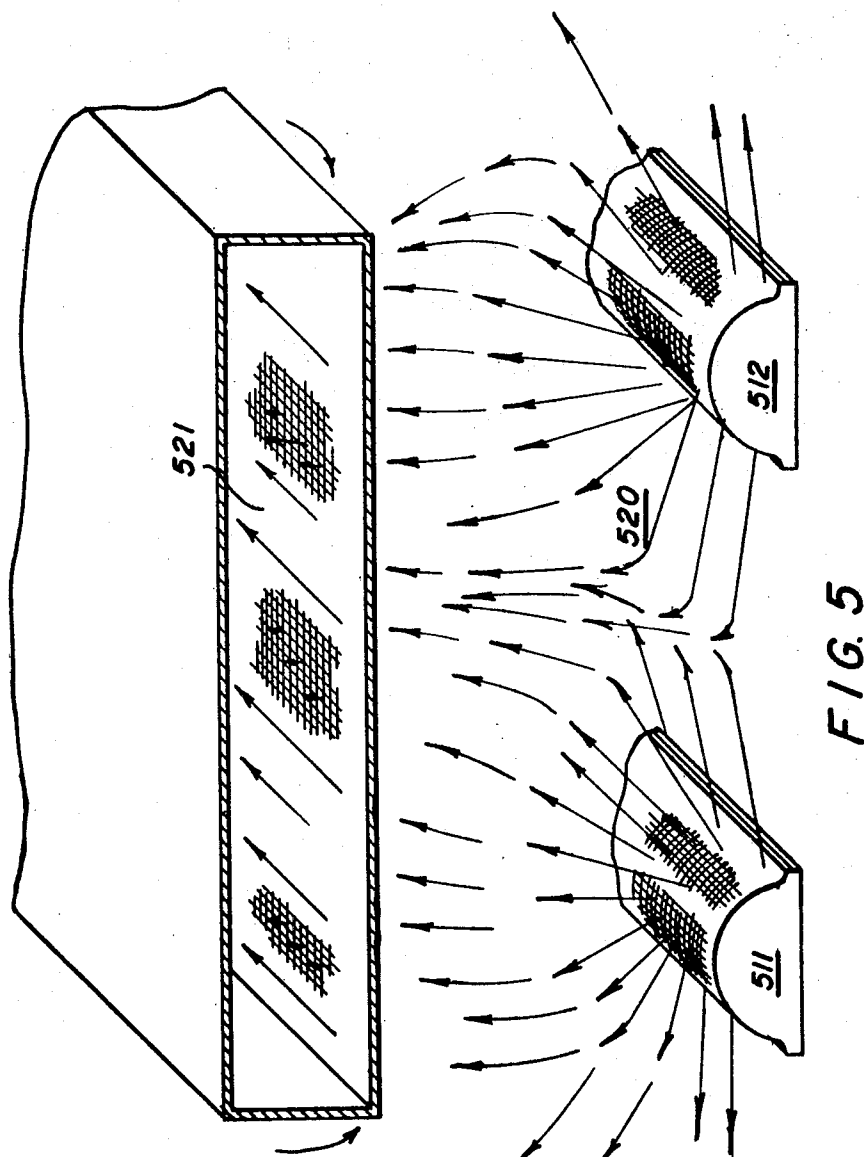
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## METHOD AND MEANS FOR PROVIDING A CLEAN AREA

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7 Claims

### ABSTRACT OF THE DISCLOSURE

A method and means for providing a particulate free area. In the past clean rooms have been created by positioning diffusers for clean air, or filters which clean the air, immediately adjacent the area to be cleaned. The clean air was beamed across the area to be cleaned and an operator who had to approach the clean area from an up-wind side contaminated the clean area. Also, diffusers and filters were of such a massive construction that frequently they limited access to the operating area. The inventor provides tubular diffuser means which are spaced about the area to be cleaned and low velocity clean air is diffused through the periphery of the diffuser means in such a fashion that currents directed inwardly towards the work area from opposite sides thereof directionally influence each other and create a resultant current substantially normal to and away from said area. In this fashion an operator is always downwind of the operating area and the diffuser means can be comparatively small in size.

### BACKGROUND OF THE INVENTION

The present invention relates to a method and means of providing a particulate free area.

It has been recognized for some time that it is essential to the successful operation of many instruments that they be assembled in so called clean rooms, that is to say in an environment which has less than one hundred particles per cubic foot of a size of .5 micron and larger suspended in the surrounding air. It is also being recognized that patients who have been surgically operated on in such an environment have a much more rapid healing rate than patients operated upon in the normal surgically "sterile" operating rooms.

A variety of solutions have been offered for creating a clean room or a clean area within a room. These solutions are generally classified as horizontal laminar flow tunnels, rooms and benches; vertical laminar flow rooms and benches; and portable absorption filter projectors. During the performance of many functions with these known devices, contaminants from the operator may be transferred to the work or the patient when it, or he, is down wind from a hand or a head of an operator. For example, in the solution offered in Canadian Pat. No. 762,194, to R. P. Thompson et al., issued July 4, 1967, clean air diffusers are provided at one end of a surgical operating table and project clean air from the foot of the operating table towards the head thereof. Obviously members of the surgical team up-wind of the incision will have particles from their person and clothing entrained in the clean airstream and directed towards the incision.

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The present invention seeks to provide an environment in which particles from an operator are not entrained onto the clean area.

### SUMMARY OF THE INVENTION

According to the present invention a method of providing a clean area comprises directing currents of low velocity clean air across the area from opposite sides thereof such that the current directionally influence each other and produce a resultant stream substantially normal to and away from said area.

In this fashion the effective flow of clean air is substantially outwardly of the operating station with the consequent reduction of the chances of contaminating particles passing from the person of the operator to the operating station.

Another disadvantage inherent in the type of solution offered in the aforementioned Canadian patent and indeed inherent in the majority of solutions to date, is that the clean air projector or diffuser has been bulky and since it is necessary to provide the diffuser in the immediate area of the operating station (the speed of the clean air diminishing by the square of the distance from the diffuser) the very presence of the diffuser cuts down the accessibility to the operating station.

The invention also provides apparatus for creating a clean area comprising a substantially tubular shaped diffuser means arranged to at least partially surround said area and adapted to receive clean air and diffuse it at low velocity across said area from opposite sides thereof. The fact that the tubular diffuser means is not bulky, permits ready access to the operating station from all sides thereof.

Yet another disadvantage inherent in present systems is that the known filtering systems operating in dirty or dusty areas becomes clogged in fairly short time because they are drawing air to be filtered through them.

A further object of the present invention is to materially increase the life of filters by providing a recirculation system which recovers the used relatively clean air recently provided to the operating area and recirculates it through the filtering system, provision being made for the introduction of make-up air.

### BRIEF DESCRIPTION OF DRAWINGS

The following is a description by way of example of certain embodiments of the invention, reference being had to the accompanying drawings in which:

FIG. 1 is a plan view of one construction in accordance with the invention;

FIG. 2 is a side elevation of the same construction;

FIG. 3 is a section on the line 3—3 of FIG. 1 looking in the direction of the arrows to an enlarged scale;

FIG. 4 is a plan view of an alternative construction; and

FIG. 5 is a section similar to FIG. 3, and not to scale, showing the provision of an extractor hood above the diffuser.

### DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings, 10 indicates a surface diffuser having a pair of substantially tubular diffusing arms 11 and 12. The diffusing arms 11 and 12 have

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a flat leather backing **11b** and **12b** and a semi-circular section active diffusing surface **11a**, **12a** of porous, finely woven, cloth material. The active section is of the order of 2" in radius. Clean air, that is air having less than 100 particles per cubic foot of a size of .5 micron and larger, is blown into a T-joint **15** from an upstream filtering unit **16**. In the filtering unit **16**, a conventional blower draws air through a prefilter and passes it through a high efficiency (HEPA) filter and then through the T-joint **15** into the diffusing arms **11** and **12** at a rate of, say, 400 feet per minute.

The clean air then diffuses radially from the semi-cylindrical surface of the diffuser arms **11** and **12** as best seen in FIG. 3 of the drawings.

The velocity of the diffused air is low and may be of the order of 50 feet per minute and is preferably of the order of 100 feet a minute or more. The operating area **20** to be cleaned lies between the arms **11** and **12** and is swept by the currents of clean air diffusing from the inner portion of the semi-cylindrical surface of each of the arms **11** and **12**, which currents are directed across the area **20** from opposite sides thereof. The spacing of the arms is selected so that these currents directionally influence each other and cause the resultant current to turn upwardly normal to the surface **20**. The air flow diffusing from the top and outsides of the diffuser arms **11** and **12** is away from the area to be kept clean and thus any one operating in the clean area **20** is subjected to a current of clean air generally outwardly and away from the clean area. Since the direction of the clean air current is towards the operator it will entrain particles from the operator's person and clothing away from the operating area and an operator approaching the operating area from any side is downwind of the operating area.

It will be appreciated that the semi-circular section surfaces **11a**, **12a** could be such that they are not porous over their outer lower sectors, provided that the porous portion of the surfaces extend far enough to provide an outwardly directed current of air against an operator when he approaches the work area. The current must be of such direction and magnitude that there will be virtually no entrainment of particles downwardly and inwardly towards the operating area **20**.

In the embodiment according to FIG. 4 the diffuser **410** is formed of a single substantially cylindrical diffuser arm **411** which is bent circularly upon itself to provide an annular diffuser means. As with the device according to FIG. 1, the inwardly diffusing air currents from opposite sides of the area **420** directionally influence each other and produce a resultant current which is substantially normal to and outwardly of the area **420** being swept. To this end the velocity of the diffusing air must be selected in proportion to the inside diameter of the annular diffuser. Since the arm **411** is of the same cross-section as the arms **11** and **12** the same radial diffusion will emit from the arm **411** outwardly against an operator approaching the work area **420**.

The diffuser **10** or **410** may be of the portable variety shown where the diffuser arms **11** and **12** or the diffuser number **410** may be brought into close proximity to the working area, and it will be appreciated that the diffuser means could equally well be triangular or rectangular in shape or be any configuration which will provide the air current pattern discussed above.

In an alternative embodiment (not shown) a non-portable diffuser means is provided by forming a work table with a pair of channels one on either side thereof. The channels are coupled to receive a clean air supply with the air being blown along the channels. In this embodiment the porous cloth diffusers connect into and span the top of the channels.

In yet a further alternative embodiment an extractor hood **521** is positioned above the diffuser arms **511**, **512** in such a fashion that the flow pattern is as indicated by the arrows. As in the embodiment of FIG. 3 the work

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station **520** lies between the arms **511** and **512** of the diffuser and is swept by currents of clean air diffusing through the arms **511**, **512**. As before the spacing of the diffuser arms **511** and **512** is selected so that the air currents therefrom directionally influence each other and cause the resultant current to turn upwardly normal to the work surface **520** and towards an extractor hood **521** positioned above the work surface. The extractor hood **521** may be connected by means of ducts in known fashion with the filtering unit **16** as seen in FIG. 1, so that the blower acts as an extractor fan to draw air from the hood to the filter. As will be seen in FIG. 5 a considerable percentage of the clean air from the diffuser arms **511** and **512** is directed upwardly towards the extractor hood **521**. Because of this there is a recovery of considerable percentage of the air which has just passed diffuser arms **511** and **512** and over the work area **520**. This ensures that the filtering unit **16** receives a large proportion of its air from cleaning from the hood **521** and requires only a relatively small volume of make-up air from the surrounding environment. The fact that the air from the diffuser **511** and **512**, when it is recovered by the hood **521** is contaminated only by particles entrained by that air during its passage over the work surface **520** and picked up between that surface and the hood **521**, ensures that this recovered air returned to the filtering unit **16** for recirculation, is at an exceptionally high degree of cleanliness. Obviously the filtering unit has a much longer life when using this recirculating air method than it would have were it simply drawing air from the surrounding environment as is current practice.

An additional advantage provided by positioning the hood **521** to recover a major percentage of the air flow from the work area **520** is that contaminants entering the airflow from the work area **520** can be captured by the hood **521**. If desired the hood instead of being connected to recirculate the air to the filtering unit **16**, may be exhausted to some safe area away from the clean area. This insures that contaminants, or unwanted gaseous effluents, from a particularly dirty operation in a clean room are disposed of outside the clean room area rather than be available as a contaminant to the environment of that area.

What I claim as my invention is:

1. A method of providing a clean area comprising providing substantially perforated tubular diffuser means in a pattern and spacing such as to surround or semi-surround the work area to be cleaned and diffusing low velocity clean air radially through the tubular diffuser means, such that currents of clean air which diffuse inwardly towards the work area from opposite sides thereof directionally influence each other and produce a resultant current substantially normal to and away from said area, and such that currents of clean air diffuse outwardly of the work area about the edges thereof.

2. Apparatus for providing a clean area comprising a source of low velocity clean air and substantially perforated diffuser means of substantially tubular configuration connected to said source and arranged to at least partially surround the area to be cleaned and to radially diffuse low velocity clean air across the area from opposite sides thereof to produce a resultant flow substantially normal to and away from said area and outwardly about the edges thereof.

3. Apparatus as claimed in claim 2 in which the diffuser means comprises a pair of spaced diffuser arms arranged on either side of the surface to be cleaned.

4. Apparatus as claimed in claim 3 in which the diffuser means has an active diffusing surface of curved cross section.

5. Apparatus as claimed in claim 3 in which the diffuser arms have a diffusing surface of semi-cylindrical cross section.

6. Apparatus as claimed in claim 4 wherein the diffuser has a stiff backing portion and the semi-circular section diffusing upper portion.

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7. Apparatus as claimed in claim 2 further comprising an extractor hood positioned adjacent said area in the path of said resultant current, said extractor hood being connected to said source of low velocity clean air to provide an air recirculation unit.

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10 WILLIAM E. WAYNER, Primary Examiner

U.S. Cl. X.R.

55—473, Dig. 29; 98—40 C