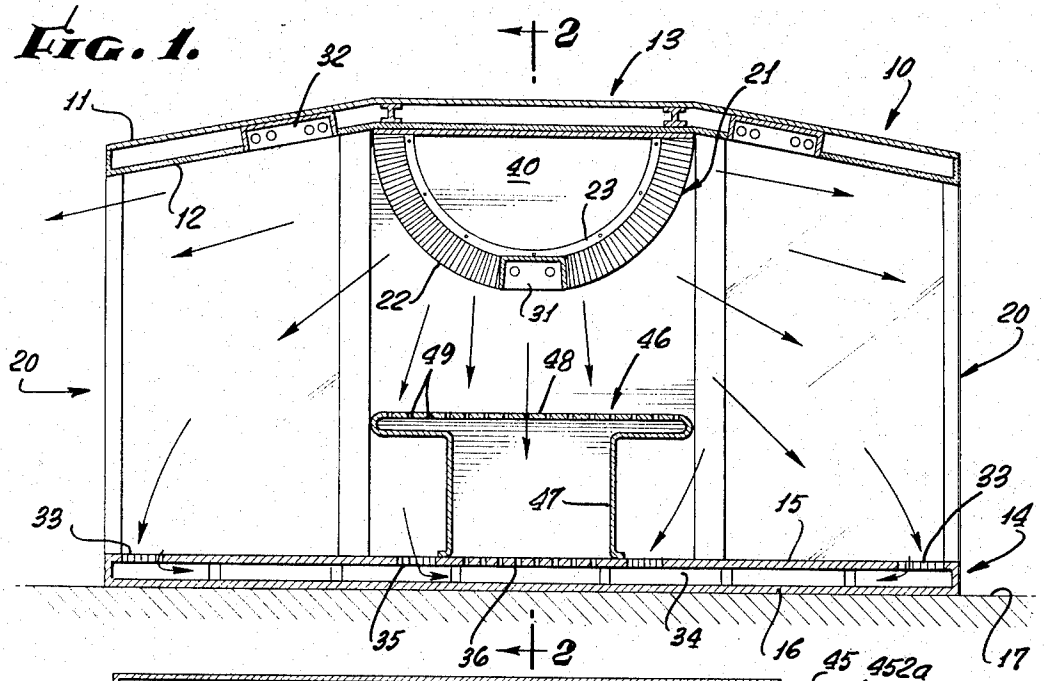
Dec. 5, 1967 R. D. SCOTT 3,356,006

CLEAN ROOM STRUCTURE

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FIG. 1.



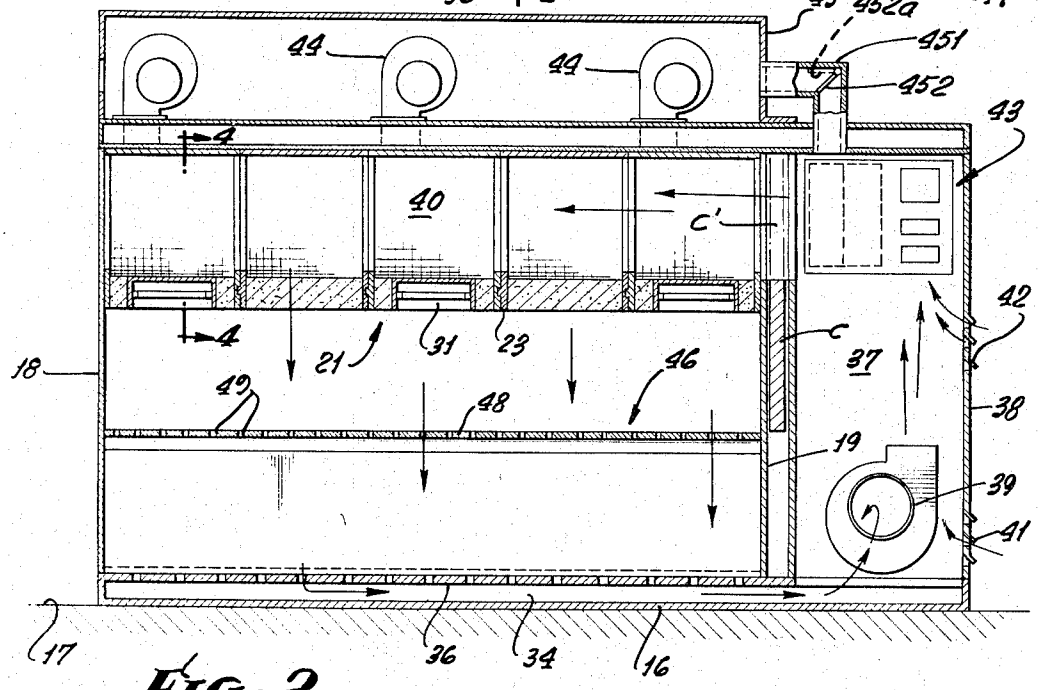


FIG. 2.

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FIG. 3.

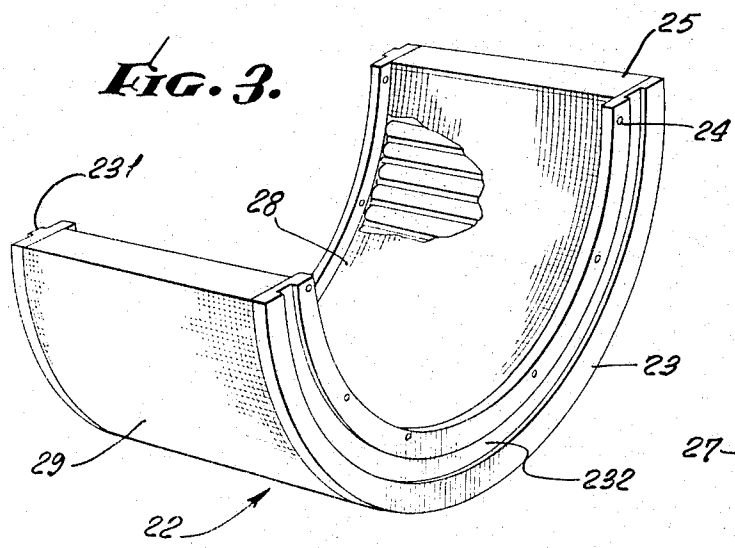


FIG. 5.

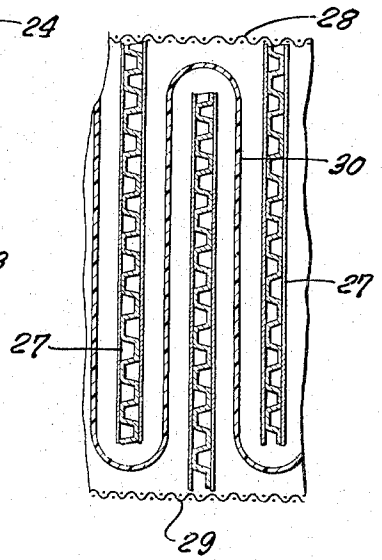


FIG. 4.

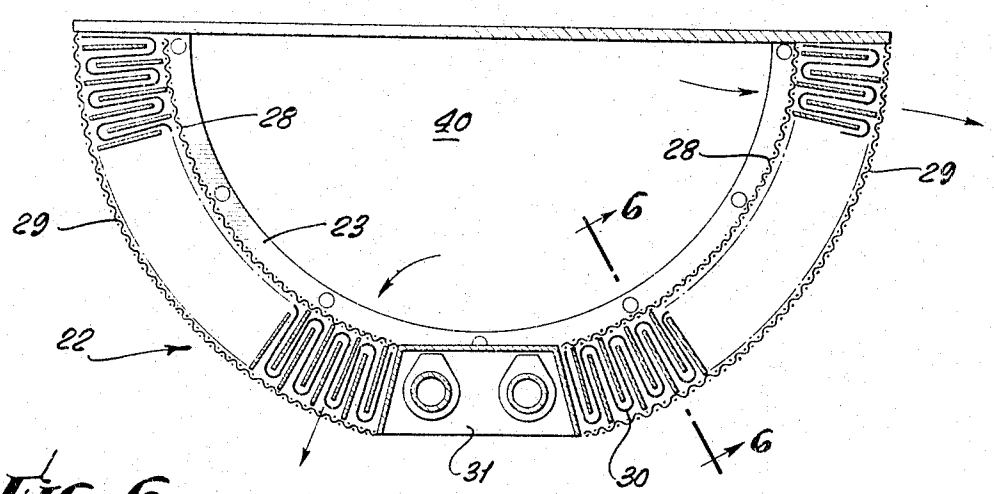
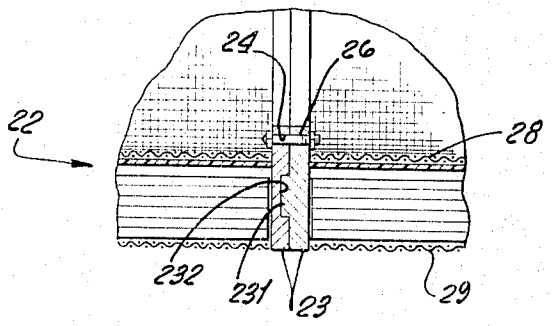


FIG. 6.



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CLEAN ROOM STRUCTURE

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18 Claims. (Cl. 98—33)

ABSTRACT OF THE DISCLOSURE

A clean room structure is provided comprising walls including a ceiling and an underlying floor structure, an air passing sub-micron filter depending from the ceiling centrally of the room having a shell whose sides extend downwardly and convergently from the ceiling, distributed apertures in the floor structure including apertures directly below the filter, a blower communicating with the filter and operating to displace air into and through the filter so that the air is discharged from the filter outwardly to the room sides and downwardly to the floor apertures in a fan-shaped pattern transversely of the room and an air return duct system whereby the blower suction draws air downwardly through the floor apertures. The novel shape of air distribution in the clean room structure serves to carry contaminants from the working zone and does not induce potentially contaminated air from the room environment even when the room is open-sided.

This invention has to do generally with so-called clean room or working area structures designed to provide and maintain for working personnel and work being performed a clean atmosphere which results from the combined effects of ventilating the work area with air cleansed by passage through a sub-micron filtering medium, and so distributing the filtered air that it sweeps the entire atmosphere of the area, and also if desired, working surfaces where dust or other contaminants may tend to deposit.

Generally considered, the invention is predicated upon the concept of providing a room structure, which may or may not itself be contained within a larger room or other enclosure, with a hollow sub-micron filter mounted centrally to the room ceiling to extend longitudinally thereof, and so shaping the filter that the air discharge therefrom completely sweeps the room atmosphere in a fan pattern extending outwardly from the filter to the room sides and progressively downward throughout the full transverse extent of the floor. The room sides may be open or closed, although for the majority of purposes the sides will be left open so that the room air going to the sides will exhaust into open atmosphere or a more confined atmosphere of a larger structure. Provision is made for positively inducing the air flow and distribution in the indicated pattern by providing an apertured floor structure containing openings distributed laterally of the room, and particularly directly below the filter, and utilizing a duct and blower system operating to draw the room air downwardly through the floor apertures, and if desired, to recircuate such air to the ceiling filter. As will appear, such return air may be vented in part and supplemented with outside air, and provision may be made for temperature conditioning the air going to the filter.

The invention further contemplates the provision of a longitudinally extended table in direct underlying relation to the filter, the table top having distributed apertures in communication with the blower suction so that air is caused to sweep and pass downwardly into and through a hollow interior of the table, thus to constantly clean its working surface by removal of dust or other particles.

These as well as various additional features and objects of the invention will be more fully understood from the following detailed description of an illustrative embodiment shown by the accompanying drawings in which:

FIG. 1 is a view showing the room structure in transverse cross section;

FIG. 2 is a longitudinal section taken on line 2—2 of FIG. 1, with an optional additional feature;

FIG. 3 is a perspective showing of one of the filter segments;

FIG. 4 is an enlarged transverse section through the filter taken on line 4—4 of FIG. 2;

FIG. 5 is a fragmentary enlargement of the filter structure; and

FIG. 6 is a fragmentary section taken on line 6—6 of FIG. 4.

Referring first to FIGS. 1 and 2, the room structure may be characterized as comprising a ceiling **10**, optionally of spaced sections **11** and **12** sloping toward a central area **13**, a floor structure **14** composed preferably of a false floor **15** spaced above section **16** or a base surface **17**, and end walls **18** and **19**. The illustrated structure **10** ordinarily will be accommodated within a larger room or other building area to provide an isolated clean and dust free atmosphere as is required for various kinds of work that must be protected against dust or like exposure. Also most usually, though not necessarily in all cases, the sides of the room are left open at **20** to provide for sweeping exhaustion of air from the room interior to the outside atmosphere.

As best illustrated in FIG. 1, air is introduced downwardly and outwardly into the room through a filter generally indicated at **21**, which is suspended from the ceiling **13** to extend centrally and longitudinally of the room as shown in FIG. 2. In the specific embodiment illustrated, the filter **21** is shown to have a transverse extent corresponding roughly to about one-third of the room width, although this relative filter dimension is variable as by reduction approximating one-fourth the distance between the open sides of the room. The invention broadly contemplates a transverse filter configuration according to which the sides of the filter converge downwardly to a bottom extent centrally overlying the floor **14**, and if used, the later described apertured table. Thus the general concept of the filter shape is that it be given a configuration such that air passing through the filter shell will sweep the room atmosphere in an essentially fan pattern extending, as indicated by the arrows, the vertical extent of the open sides **20** as well as the horizontal extent of the floor **14**.

Preferably, though typically, the filter shell **22** is given an arcuate downward curvature symmetrically in relation to the transverse extent of the room, and has an over-all segment cylindrical shape extending between the end walls **18** and **19** of the room. While capable of construction in any of various specific forms, the filter shell **22** will be designed generally to contain a sub-micron filtering medium or membrane which may be of any known suitable commercially available types, as for example glass-asbestos membrane known as an Absolute Filter manufactured by Cambridge Filter Corporation of Syracuse, N.Y. For present purposes it will suffice to characterize such known membranes as having intimately distributed pores capable of filtering from air passing through the pores, dust particles as small as submicron in size, thus to thoroughly cleanse the air to substantially complete elimination of dust particles that could possibly contaminate, in this instance, the clean room atmosphere.

FIGS, 3 to 6 show an illustrative construction of the filter shell **22** according to which the latter is made in sections each comprising arcuate ends **23** having bolt holes **24** and pieces **25** attachable by suitable means such as bolts or screws or other mountings to the central ceiling **12**. Air seals between each engaging pair of ends **23**

may be provided by an arcuate tongue **231** received within a corresponding groove **232**, as shown in FIG. 6. Successive sections of the filter shell are fastened together by bolts **26** inserted through the holes **24**. Each of the sections contains radially extending supports **27** projecting in staggered or offset relation from inner and outer screen enclosures **28** and **29**, these supports typically being made of cellular paperboard having sufficient strength and rigidity to support and position the filter membrane **30**. The latter being thin, flexible and of sub-micron porosity as previously indicated, is suitably secured at its sides to the section ends **23** and is extended reversely in essentially pleated or accordion shape between the supports **27**, thus to provide adequately large surface area for the membrane to pass the necessary air throughput without excessive pressure drop.

At suitable intervals the filter segments may contain light fixture inserts **31** for illumination of working area directly below. The ceiling structure **10** may contain additional light fixtures as at **32**.

Provision is made in the floor structure **14** for inducing air flow from the room atmosphere at locations so distributed as to assure maintenance of the illustrated flow pattern. Such induced air flow may be effected continuously across the floor or at such selected locations as will in practical effect maintain the fan-shaped air flow pattern toward and across the bottom of the room. As illustrative, grills **33** may be provided in the false floor **15** for induction of air into the sub-floor space **34**, and similar grills **35** and **36** may be utilized for the withdrawal of air from the central floor area. The space **34** provides a duct leading openly into compartment **37** beyond the room end wall **19**, and itself having an end wall **38**. The compartment contains a motor driven blower **39**, the suction of which induces air flow from the room atmosphere down through the false floor apertures or grills, at least a portion of such air being recirculated by the blower upwardly through compartment **37** into duct **40** within the filter shell, thence to be forced out through the filter in the described pattern. Provision may be made for admitting outside air to the compartment **37** as through grills **41** and **42** or other appropriate means. Additionally, it may be desired to temperature condition the air going to the filter, for which purposes a combined and selectively operable heating and cooling unit diagrammatically indicated at **43**, may be installed in the compartment.

If for any reason it is desired to alternate or supplement the air delivery of blower **39**, air from the outside through e.g. an openable vent V, may be provided by one or more ceiling-supported blowers **44** positioned within a suitable housing **45** and discharging downwardly into the filter duct **40**. This same structure may be used instead of the described system employing blower **39** for air delivery to the filter shell, with or without induced air recirculation. Thus, by providing suitable ducting as at **451** communicable with space **34** as by way of a duct or chamber **37**, and by providing an air control such as valve or damper **452** which may be closed as in FIG. 2, or swung open to the **452***a* dotted open position, the blowers **44** may operate to discharge non-recirculated air when the valve is closed, or to induce and discharge recirculated air. Under the latter condition, closure C may be raised to the dotted C′ position to close off direct communication between chamber **37** and the filter shell.

A constantly cleansed, extended working surface may be provided by table generally indicated at **46** which may be extended the full length of the room, or any portion thereof, the table being shown to have a hollow base **47** in open communication wtih the floor apertures **36**, and a top **48** containing apertures **49** so that air passing downwardly from the filter can be induced by the blower suction down through the table to the recirculation duct **34**. The table top apertures **49** are given sufficiently close spacing and distribution over the working surface of the table, as to assure constant and substantially complete removal in the induced air streams, of dust and other solid particles which might otherwise be retained upon the table top.

It is to be understood that the drawings are illustrative of the invention in typical embodiments and that various changes and modifications may be made without departure from the invention in its intended scope.

I claim:

1. A clean room structure adapted to accommodate working personnel comprising,

(A) walls including a ceiling and an underlying floor structure,

(B) a hollow elongated air passing sub-micron filter depending from the ceiling centrally within the room and having a filter supporting shell the sides of which extend downwardly and convergently from the ceiling,

(C) distributed apertures in said floor structure including apertures directly below the filter,

(D) a blower communicating with the filter and operating to displace air into and through the filter so that the air is discharged therefrom outwardly to the room sides from near the ceiling and downwardly to said floor apertures in a fan-shaped pattern extending radially from said filter within and transversely of the room thereby to positively displace and sweep the room atmosphere both outwardly and downwardly in said pattern, and

(E) an air return duct system whereby the blower suction drawings air downwardly through the floor apertures.

2. The structure of claim **1**, in which the room sides are open.

3. The structure of claim **1**, in which the shell of said filter is arcuately curved.

4. The structure of claim **3**, in which the room sides are open and said floor apertures are located both beneath and laterally offset from below the filter.

5. The structure of claim **1**, in which said floor structure includes an upper false floor and said duct system includes space below the false floor.

6. The structure of claim **1**, including also a table directly underlying said filter and having an apertured top through which air is drawn downwardly to and through said floor apertures directly below the filter.

7. The structure of claim **6**, including a light fixture carried by the bottom of the filter shell to centrally illuminate the table.

8. The structure of claim **6**, in which the filter shell is of substantially segmental cylindrical form.

9. The structure of claim **6**, in which the sides thereof are open so that air from the filter sweeps the room atmosphere outwardly from the room as well as downwardly through the table top and floor structure.

10. The structure of claim **6**, in which said floor structure includes an exposed false floor having an air space therebeneath and communicating with the blower, and said table has a hollow base through which the table top apertures communicate with said air space.

11. The structure of claim **10**, including also walls at one end of the room forming an air duct containing the blower and interconnecting said space with the filter.

12. The structure of claim **10**, including means in said duct for temperature conditioning the air going to the filter.

13. The structure of claim **10**, including means for admitting atmospheric air to said duct.

14. The structure of claim **1**, in which said filter comprises pleated micro-porous sheet material and means for supporting the material in its pleated form.

15. The structure of claim **6**, in which said filter comprises pleated micro-porous sheet material and means for supporting the material in its pleated form.

16. A clean room structure adapted to accommodate working personnel comprising,

(A) walls including a ceiling and an underlying floor,

(B) a hollow elongated filter shell depending from the ceiling centrally of the room and having an air passing shell the sides of which extend downwardly and convergently from the ceiling,

(C) a sub-micron filter membrane within the shell and serving to pass and filter air from within the shell into the room, and

(D) blower means communicating with the filter shell and operating to displace air into the filter and through the membrane so that the air is discharged downwardly and outwardly in a fan-shaped pattern symmetrically transversely of the room extending from the ceiling on either side of said filter membrane to the sides thereof to and across the floor.

17. A room structure according to claim **16**, in which opposite sides of the room are open to the atmosphere outside the room.

18. A room structure according to claim **16**, in which said filter shell is essentially semi-cylindrical in shape.

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