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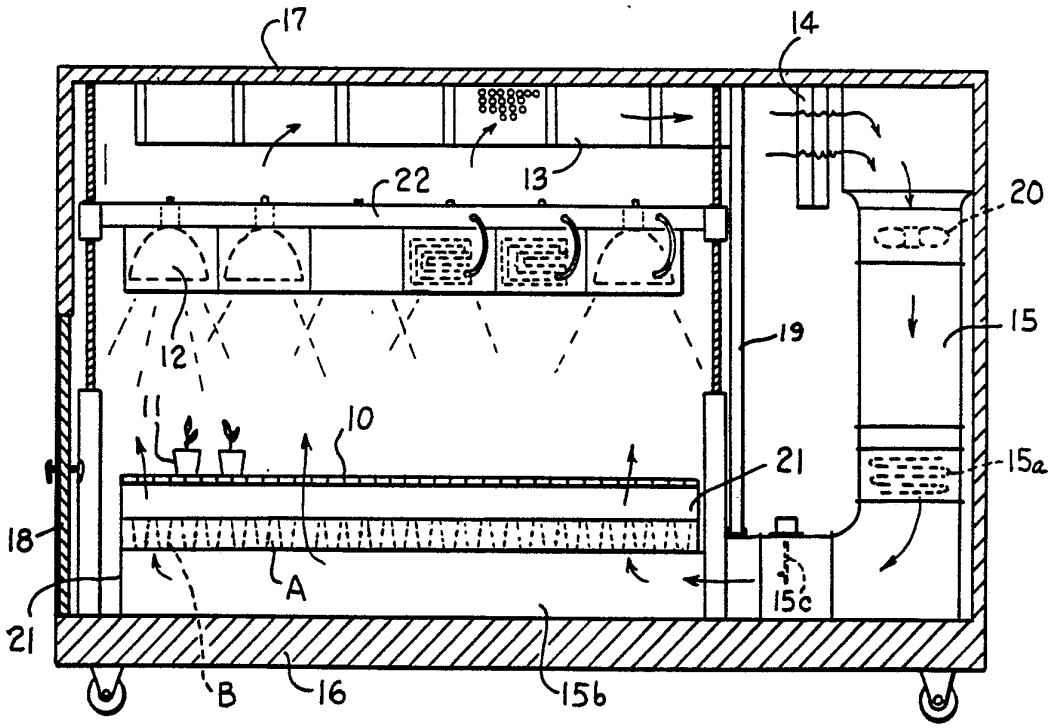

(57) Abstract

A fluid distribution panel (A) is illustrated, especially for use in a growth chamber (17), utilizing a plurality of spaced conical surfaces (25) which taper outwardly from a plenum into an enlarged fluid discharged opening (26) for controlling the distribution of air across the plenum with minimal pressure drop or variation.

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FLUID DISTRIBUTION PANEL

Background of the Invention

Diverging conical nozzles have been used in individually as diffusers or as turbine nozzles and the like.

To distribute air across an enlarged area, such as required in growth chambers and the like, it is customary to utilize a panel having holes spaced across the panel. Whether holes or other nozzles are provided in the panel, it is desirable that air be distributed in a predetermined pattern, usually as uniformly as possible from one end of the panel to the other. Air flow should preferably be laminar over a relatively large area across the panel. Should openings of equal size and spacing be employed in the panel, the pressure drop causes the air flow to diminish from one end of the panel extending across the supply plenum to the other. It is desirable, therefore, to control the flow of air so as to equalize its flow across the entire plenum by minimizing the pressure drop and by minimizing turbulence, preferably producing flow in the laminar region or at least smooth flow in a region of minimized turbulence. A growth chamber, capable of utilizing a panel of the type illustrated herein, is described in United States Patent No. 3,124,903.

Accordingly, it is an important object of this invention to provide an air distribution panel wherein fluid distribution may be controlled through nozzles spaced across the entire panel or manifold with minimal pressure drop. It is possible to vary the size and pattern of the conical, diverging discharge openings and vary the distribution from area to area across a plenum.

Summary of the Invention

It has been found that a fluid distribution panel may be constructed utilizing a grid containing spaced individualized conical members having the small end opening into a plenum or utilizing a block of construction material such as air entrained material as an expanded polyurethane foam wherein the spaced conical surfaces taper outwardly into an enlarged fluid discharge opening resulting in minimized pressure drop with reduced turbulence and uniform, high volume air flow across a wide area of the panel.

Brief Description of the Drawings

The construction designed to carry out the invention will be hereinafter described, together with other

features thereof.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown and wherein:

Figure 1 is a sectional side elevation of a growth chamber equipped with an air distribution panel constructed in accordance with the present invention,

Figure 2 is an enlarged perspective view illustrating an air distribution panel constructed of expanded polyethylene and the like,

Figure 3 is an enlarged sectional elevation taken on the line 3-3 in Figure 2,

Figure 4 is a perspective view illustrating a modified form of panel in a growth chamber environment, and

Figure 5 is an enlarged sectional elevation taken on the line 5-5 in Figure 4.

Description of a Preferred Embodiment

The drawings illustrate a fluid distribution panel A for use in a fluid distribution plenum. A plurality of spaced openings in the panel are formed by a plurality of

spaced conical surfaces B tapering outwardly in an ever increasing cross section. A portion of each of the conical surfaces open into the plenum and taper outwardly into an enlarged fluid discharge opening. Thus, turbulence in a fluid flowing from the source is reduced resulting in a minimized pressure drop across the distribution panel. Preferably the conical surfaces have an included angle of about 7 to about 15 degrees.

The drawings further illustrate a growth chamber having a foraminous table 10 for circulating heated air upwardly therethrough and past plants 11 carried on the table and thence through a source of heat and light such as provided by the light fixtures 12. The air then flows through a receiving plenum 13 and a velosity eliminator 14 into a plenum 15 containing coils 15a for heating and cooling and which extends as at 15b beneath and across the table 10. A suitable humidifier 15c and other conditioning and control means are provided as desired depending upon the requirements for the growth chamber. The panel is illustrated at A containing a plurality of spaced openings therein formed by a plurality of spaced, smooth, conical surfaces B which taper outwardly in an ever increasing cross section. The lower portion of each of the conical surfaces opens into the plenum and tapers outwardly into an enlarged fluid discharge

opening. Thus, turbulence in the air flowing across the table is reduced resulting in a minimized pressure drop with control of air flow uniformly across all areas of the table.

Referring more particularly to Figures 1 and 4, the growth chamber is illustrated as including a base 16 carrying an insulated housing 17. The growth chamber has a door 18 therein for access by workers into the interior of the growth chamber, and is partitioned as at 19 providing a compartment for carrying the velocity eliminator as well as a fan for removing air into the plenum 15 and the flow path described above. The table 10 is carried on suitable supports 21 on either side of the lower extension 15b of the plenum. A support 22 is provided for carrying the light fixtures 12 for providing a controlled source of heat and light for the growth chamber.

Figure 4 best illustrates the table in the form of a grating 10. A sprinkler system includes a pipe 23 carrying nozzles 24. The air distribution panel A is illustrated as being positioned across and beneath the table and forms a portion of the plenum 15b. The panel A may be considered as an upper wall of a plenum or in this instance, an intermediate wall dividing upper and lower portions of a single plenum.

Figure 3 illustrates a preferred embodiment of the invention wherein the air distribution panel A is formed from a block of expanded polystyrene or other suitable lightweight construction material as may be provided, for example, through air entrainment. The tapered surfaces B are provided in the panel and have walls arranged preferably at about a 7 to 15 degree included angle. An angle in this range of divergence provides a natural expansion angle. It is believed that angles of divergence from about 5 to 25 degrees would be useful. Although the angle may be expected to vary from the ideal, the more desirable relationships may be determined from the formula and method illustrated in Basic Fluid Mechanics, J. Lister Robinson, 1963 at pages 48-51.

Referring to Figures 2 and 3, it will be observed that the opening 25 is relatively small as the conical surfaces open into the plenum and taper outwardly in an ever increasing cross section into a larger opening 26 which serves as a distribution opening. Figure 3 illustrates a panel made of lightweight construction material. A depth of 8 inches with a cone having an opening diverging from 3/8 inches to 1 1/4 inches has been found to give desirable results. The edges of the inner smooth conical surfaces may be beveled at the entrance and exit as at 25a and 26a, respectively, to minimize eddy currents or other turbulence,

thus increasing the efficiency of the air flow reducing pressure drop.

Referring more particularly to Figures 4 and 5, it will be noted that a modified form of the invention is illustrated wherein the grid of the panel A for containing the conical surfaces is supplied by a thin member rather than by a structural block member. A sheet 27 has a plurality of spaced openings 28 therein for containing conical members 29 each having a conical surface B therein. It has been found that suitable cones may be provided in the form of paper tubes of the type upon which yarn is wound to form packages by the textile industry. The cone preferably extends for about one third of its total length into the sheet 27 as illustrated in Figure 5.

It is thus seen that an air distribution panel has been provided containing spaced conical openings which extend generally normal to the plane of the panel. The openings diverge from an inner opening in order to provide even flow across the entire panel. Thus, all areas of a panel may have controlled uniform air flow. If desired, the air flow may be controlled such as to vary the air flow from area to area across the panel. This may be done by varying the size of the conical elements formed by the conical surfaces. Further

control of air flow may be obtained by varying the pattern at which the conical surfaces are spaced across the panel.

While a preferred embodiment of the invention has been described using specific terms, such description is for illustrative purposes only and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.

What is claimed is:

1. For use in a fluid distribution apparatus having a source of fluid, a fluid distribution panel comprising:

a plurality of spaced openings in said panel formed by a plurality of spaced conical surfaces tapering outwardly in an ever increasing cross section; and

a portion of each of said conical surfaces opening into said apparatus and tapering outwardly into an enlarged fluid discharge opening;

whereby turbulence in a fluid flowing from said source is reduced resulting in a minimized pressure drop across said distribution panel.

2. The structure set forth in claim 1 wherein said conical surfaces have an included angle of about 7 to about 15 degrees.

3. The structure set forth in claim 1 wherein said distribution means is contained in a growth chamber for distributing air across a growth table.

4. The structure set forth in claim 1 wherein said panel includes a grid having a plurality of spaced openings, and said conical surfaces being contained in hollow cone shaped members carried in said grid.

5. The structure set forth in claim 1 wherein said panel is a thickened block constructed of synthetic foam and said spaced conical surfaces are formed therethrough.

6. For use in a growth chamber having a foraminous table for circulating heated air upwardly therethrough and past plants carried on said table through an array of light fixtures past a velosity eliminator into a apparatus extending beneath and across said table, the improvement including:

a plurality of spaced conical surfaces in said apparatus each tapering outwardly in an ever increasing cross section; and

each of said conical surfaces opening into said apparatus tapering outwardly into an enlarged fluid discharge opening;

whereby a constant supply of heated air is distributed in controlled areas across said table.

7. The structure set forth in claim 6 wherein said conical surfaces are formed in a block of air entrained material.

8. A fluid distribution panel comprising:

a block of construction material;

a plurality of spaced openings in said block

formed by a plurality of spaced conical surfaces tapering outwardly in an ever increasing cross section; and

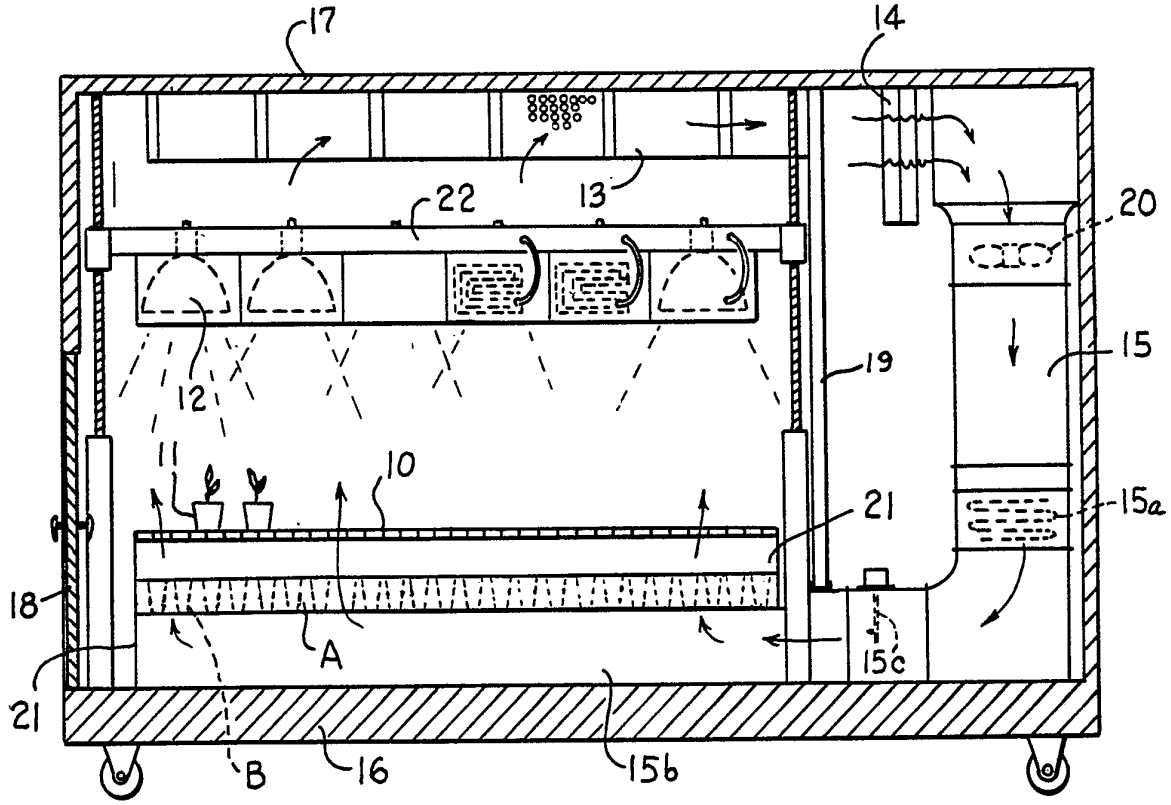
a portion of each of said conical surfaces opening into a supply of fluid and tapering outwardly into an enlarged fluid discharge opening;

whereby turbulence in fluid eminating from said supply is reduced resulting in a minimized pressure drop across said distribution panel.

9. The structure set forth in claim 8 wherein said conical surfaces have an included angle of about 7 to about 15 degrees.

1/2

Fig. 1.



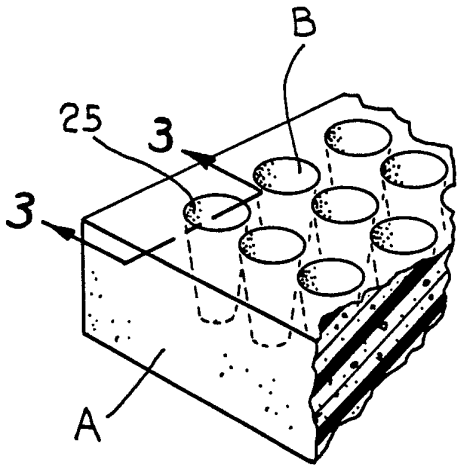


Fig. 2.

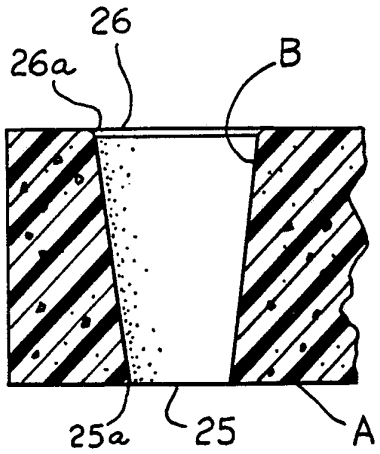


Fig. 3.

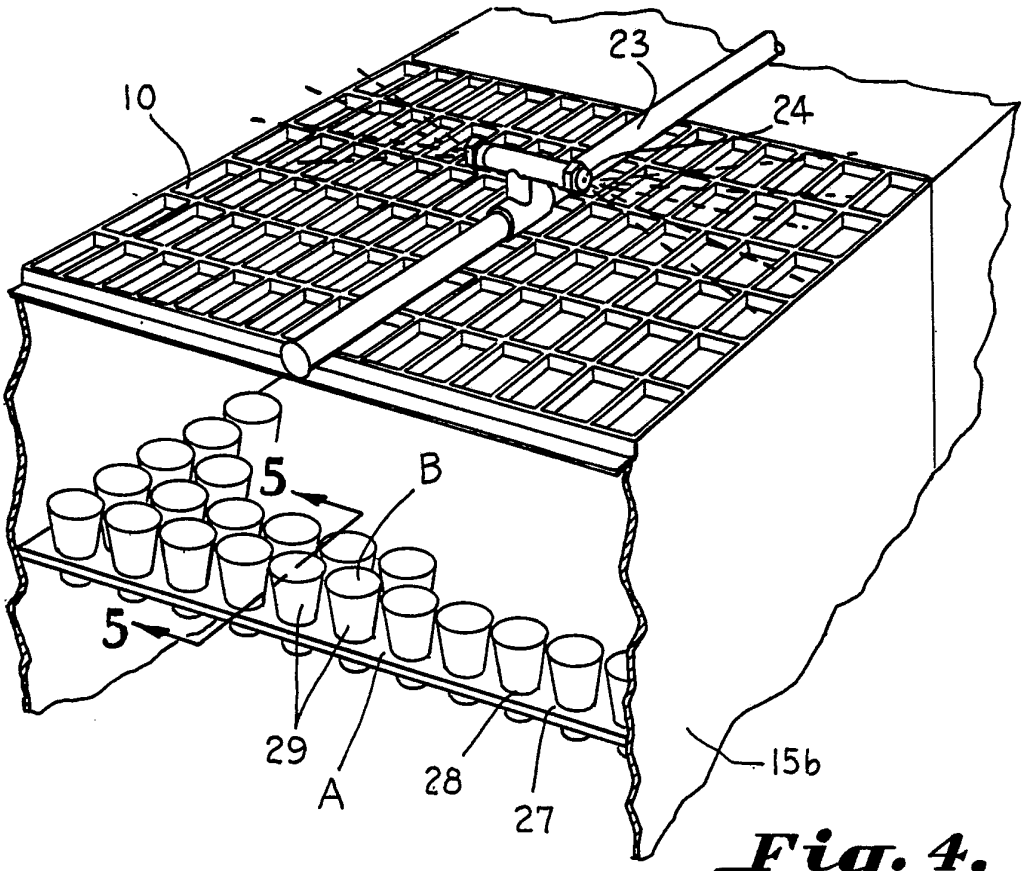


Fig. 4.

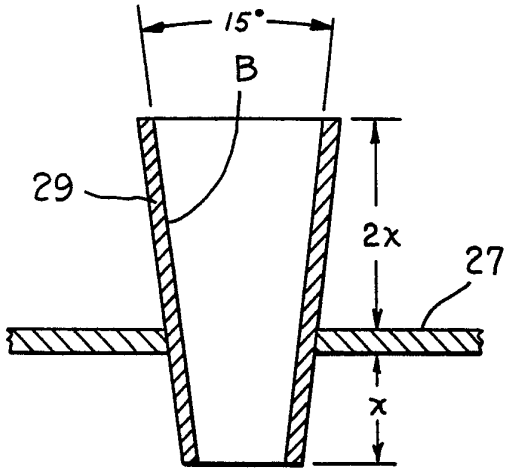


Fig. 5.

INTERNATIONAL SEARCH REPORT

International Application No PCT/US85/00947

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int Cl[4] A01G 9/00
US Cl 47/17

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
US	47/17, 18, 63, 59, 82, 86, 87 34/57A, 237, 225

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]		Relevant to Claim No. [18]
X	US, A, 3,980,439	14 September 1976 MAYER	2, 9
Y	US, A, 3,810,329	14 May 1974 LECURU et al	5
Y	US, A, 3,667,159	06 June 1972 TODD	5
X	US, A, 3,124,903	17 March 1964 TRUHAN	1, 6
Y	DE, A, 111,786	07 October 1968 SORENSON	4

* Special categories of cited documents: [15]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
8/5/85	14 AUG 1985
International Searching Authority [1]	**Signature of Authorized Officer [20]**
ISA/US	Robert A. Hafer