June 28, 1966 J. AVERNA 3,257,930

SHELTER WITH VENTILATION MEANS

Filed Jan. 10, 1964

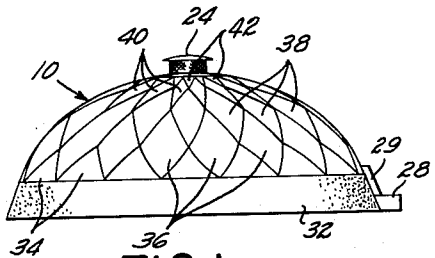


FIG. 1

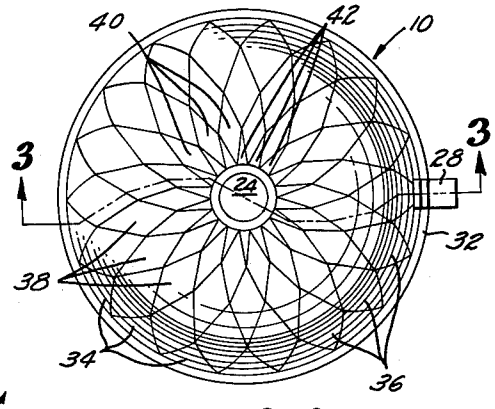


FIG. 2

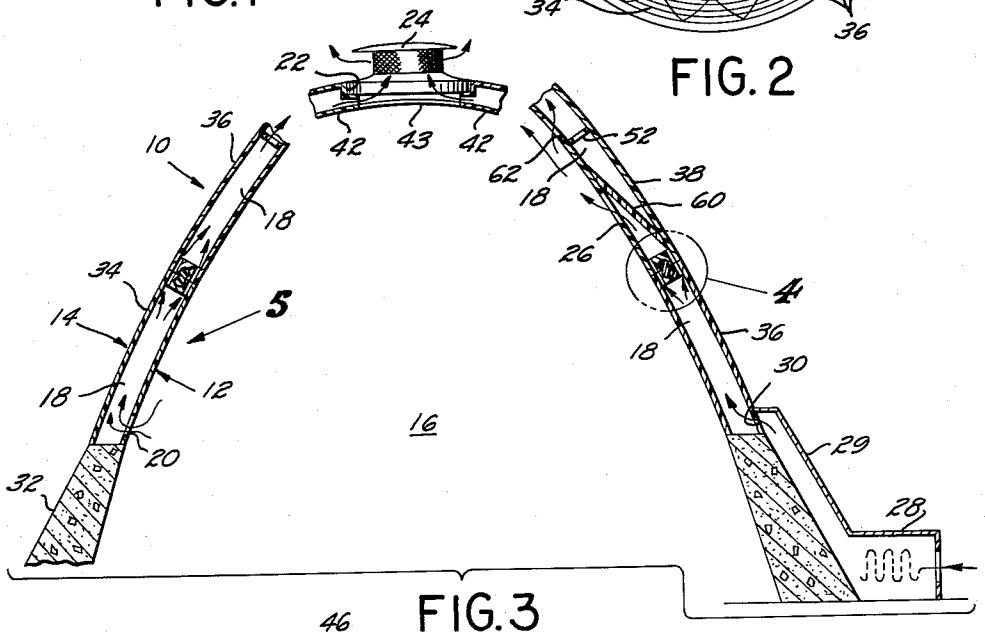


FIG. 3

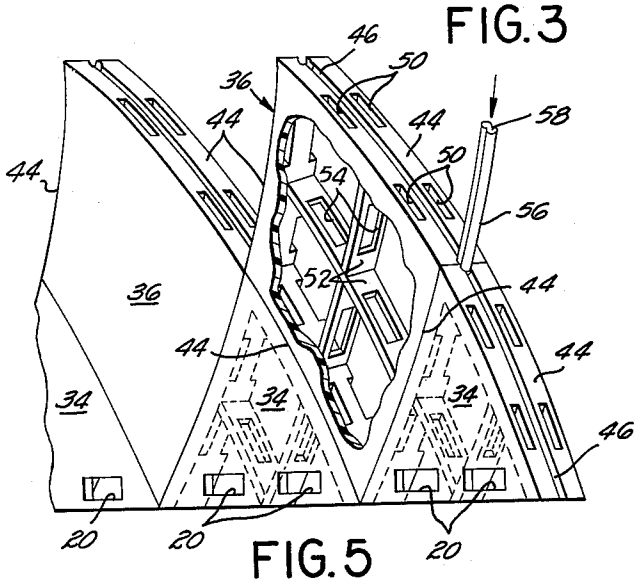


FIG. 5

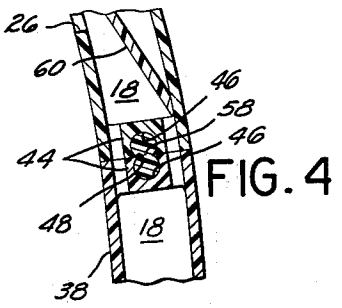


FIG. 4

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SHELTER WITH VENTILATION MEANS

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The present invention relates to a shelter and more particularly to a dome-shaped shelter adapted for covering comparatively large areas.

The successful control of weather conditions is still beyond our present technology, although a relatively limited control of environmental conditions has been achieved in homes and office buildings and the like. However, there has heretofore been no way of providing adequate shelter or environmental control for comparatively large areas such as shopping centers, large manufacturing facilities, and the like. Such control would provide a number of important advantages. The sheltered area could be heated and cooled as desired, shielded from ambient temperature extremes and inclement conditions, and provided with air filtered to remove noxious and irritating fumes, this last advantage being particularly important in those areas plagued with smog conditions.

Accordingly, it is an object of the present invention to provide environmental control by means of a shelter completely covering the area to be protected. The shelter components are made of relatively inexpensive light-transmitting material, and are comparatively simple to assemble and include passages for cooling, heating, and ventilating the area covered by the shelter.

It is another object of the invention to provide a shelter capable of being made large enough to cover comparatively large areas and which incorporates components adapted for this purpose.

Another object of the invention is the provision of a dome-shaped shelter which utilizes a pair of internested, light-transmitting, and dome-shaped shells spaced apart to define air passages for the circulation of air between the shells.

Another object of the invention is the provision of a pair of internested shells defining a shelter, and wherein each shell is constituted of a plurality of blocks or elements which are readily and quickly connectible to form a shelter without conventional trusses and braces.

Other objects and features of the invention will become apparent from consideration of the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevational view of a dome-shaped shelter according to the present invention;

FIG. 2 is a plan view of the shelter of FIG. 1;

FIG. 3 is a view taken along the line 3—3 of FIG. 2, parts being broken away for brevity;

FIG. 4 is a detail view of the interconnection between a pair of the blocks constituting the main body of the shelter of FIG. 1; and

FIG. 5 is an enlarged view of the base of the shelter, as viewed in the direction of the arrow 5 in FIG. 3.

Referring now to the drawings, there is illustrated a shelter **10** which is generally dome-shaped in configuration, although it will be understood that the shelter could also be made elongated, with the ends of the elongated structure being half-domes interconnected or spanned by a substantially semi-cylindrical intermediate structure, as will be apparent.

The shelter **10** comprises inner and outer dome-shaped, internested, and light-transmitting shells **12** and **14** which define an enclosed area **16**. The shells **12** and **14** are spaced apart to define a plurality of air passages **18** therebetween. The inner shell **12** includes a plurality of air inlet openings **20** adjactnt the base thereof, while

the outer shell **14** includes an air outlet opening **22** adjacent the top thereof. With this arrangement, stagnant air is vented from the enclosed area **16** through the air inlet openings **20**, through the passages **18**, and thence to the exterior of the shelter **10** by means of the air outlet opening **22**.

To facilitate venting of the air from the interior of the shelter **10** in the manner just described, a usual and conventional motor-driven or wind-actuated ventilator **24** is secured to the top of the shelter **10** in any suitable manner with its inlet in communication with the air outlet opening **22**. Thus, actuation or operation of the ventilator **24** draws air from the enclosed area **16**, through the passages **18**, and out of the air outlet opening **22** to the exterior of the shelter **10**. It will be apparent that when the shelter **10** is exposed to strong sunlight, the air in the passages **18** rises in temperature and characteristically flows upwardly and out of the air outlet opening **22**. Moreover, the air in the passages **18** forms a natural barrier to heat transmission through the internested shells **12** and **14**, and any flow of air through the passages **18**, naturally or by virtue of the ventilator **24**, has the desirable effect of carrying away heated air during hot days. The rate of flow between the air outlet opening **22** and the air inlet openings **20** can be controlled as desired by regulation of the operation of the ventilator **24**, as will be apparent.

The inner shell **12** also includes one or more air discharge openings **26** which are located above the base of the shelter **10** for discharging heating, cooling, or otherwise conditioned air into the enclosed area **16**. A suitable air conditioning plant, such as the heating and cooling unit **28**, is located outside the shelter **10** with its discharge conduit or manifold **29** connected to an opening **30** affording fluid communication with the passages or space between the shelter shells **12** and **14**. The baffle structure by which the heating and cooling air for the interior of the shelter is segregated from the air being vented from the shelter through the passages **18** will be described more particularly hereinafter.

The bases of the shells **12** and **14** are supported upon a circumferential foundation **32** made of reinforced concrete or the like. The shelter **10** is preferably hemispherical for optimum structural integrity, although its vertical dimensions are reduced as much as possible for comparatively large areas, such as a large shopping center, where the area to be enclosed is sufficiently great that the vertical height of the shelter could become a navigational problem for aircraft.

The inner and outer shells **12** and **14** are constituted by a plurality of interfitted or interengaged elements or blocks **34**, **36**, **38**, **40** and **42**. The blocks **34** are substantially triangular and are attached at their bases in any suitable manner to the foundation **32** to form a continuous circular pattern. The blocks **36**, **38** and **40** are generally diamond-shaped in configuration and are interfitted in ascending levels above the blocks **34**, the two lower edges or edge walls of the blocks **36** extending between and engaging the adjacent edge walls of a pair of adjacent blocks **34**. The upper pair of edge walls of each block **36** extend between and engage the adjacent edge walls of a pair of adjacent blocks **38**, as best viewed in FIG. 2. Likewise, the pair of upper edge walls of each block **38** extend between and engage the adjacent edge walls of a pair of adjacent blocks **40**, and the upper edge walls of each block **40** extend between and engage the adjacent edge walls of a pair of adjacent blocks **40**, and the upper edge walls of each block **40** extend between and engage the adjacent edge walls of a pair of adjacent triangularly-shaped blocks **42**. The bases of the blocks **42** define a circle in the outer shell **14** within which the ventilator **24** is mounted, and a circular crown piece **43**

is connected across the bases of the blocks 42 as a continuation of the inner shell 12 for the purpose of channeling vented air out of the ventilator 24.

A number of different patterns of shelter components or blocks may be devised which would be suitable for the shelter 10, so long as the blocks thereof are arranged to define internested inner and outer shells of the character above-described. Moreover, the blocks may be connected together in a number of different ways, as for example as shown in United States Letters Patent No. 2,944,370, issued July 12, 1960. However, a preferred structure to effect such interconnection will next be described.

Each of the blocks is characterized by opposite or facing walls of light-transmitting material which are spaced apart and bounded by edge walls 44 which are similarly configured and constructed in the several blocks 34, 36, 38, 40, and 42, except for those edge walls of blocks 42 and 34 which support the ventilator 24 and which rest upon the foundation 32, respectively. More particularly, each of such edge walls 44 is characterized by an elongated track or groove 46 which, as best viewed in FIG. 4, is generally cylindrical in configuration but which is characterized by a narrow throat or entry portion 48. In addition, each edge wall 44 includes a plurality of passages or openings 50 on opposite sides of the groove 46 to permit the passage of air between adjacent blocks so that air may flow without interruption throughout most of the space between the shells 12 and 14 for venting out of the air discharge opening 26 at the top of the shelter.

The blocks are also characterized by intersecting reinforcing ribs 52 having air passages or openings 54 therethrough, and which engage the edge walls 44 and the spaced light-transmitting walls of the block to provide structural rigidity.

The blocks are connected together by butting the edge walls 44 thereof and sliding an elongated and resilient locking or connecting strip 56 into the adjacent grooves 46 of an abutting pair of blocks. The connecting strip 56 includes substantially cylindrical side portions which fit within the grooves 46, and also includes a narrower central portion 58 interconnecting the side portions and adapted for reception within the entry portions 48 of the abutted blocks to prevent the blocks from being pulled apart. For this purpose, the connecting strips are made of a tough, durable plastic material or steel or similar metal which can be conformed to the curvilinear configuration of the abutting grooves 46 of the respective blocks for insertion therein.

The blocks are made of any suitable plastic material adapted to transmit light, and preferably a plastic reinforced with glass fibers or the like for structural strength.

As best viewed in FIGS. 3 and 5, the air inlet openings 20 are located in the inner wall of the lower tier of triangular blocks 34, and the air outlet opening 22 is defined by the adjoining bases of the triangular blocks 42 in the curving path of the outer shell 14.

The air discharge opening 26, as best viewed in FIGS. 3 and 4, is provided in the inner facing wall of one of the blocks 38, and a baffle 60 is diagonally disposed between the outer and inner walls of the block to prevent upward passage of heating or cooling air through the block 38. Instead, the air is forced out of the opening 26. In addition, the edge walls 44 of the particular block 38 illustrated in FIG. 4, and also those blocks between it and the heating and cooling manifold 29, are absent any air flow opening, such as the opening 50, except for those edge walls in a substantially direct line from the manifold 29 to such particular block 38. Thus, the passage of air from the unit 28 is constrained to flow out of the air discharge opening 26 and not throughout any of the other space between the shells 12 and 14. Of course, any number of air discharge openings 26 may be

provided and connected to the manifold 29, in which case the number of such paths for heating and cooling air will be correspondingly multiplied.

The blocks above that block 38 which has the air discharge opening 26 therein are utilized for venting air from the enclosed area 16 to the air outlet opening 22 by providing a second air inlet opening 62 in such block 38 immediately above the baffle 60, as best viewed in FIG. 3.

From the foregoing it will be apparent that by utilizing a number of the blocks 34, 36, 38, 40 and 42, the shelter 10 can be constructed to cover and afford environmental control for a relatively large enclosed area 16. The shelter admits light, is comparatively simple to assemble, and includes integral psasages for cooling, heating, and ventilating the area 16. The employment of the inter- and includes integral passages for cooling, heating, and bracing structures, and constant circulation of air between the internested shells affords a means for carrying away heated air which would otherwise collect between the shells on a hot day. Moreover, isolation of the enclosed area 16 from its environment permits close control of the quality and character of the air circulated within the area.

Various modifications and changes may be made with regard to the foregoing detailed description without departing from the spirit of the invention or the scope of the following claims.

I claim:

1. A dome-shaped shelter comprising:

inner and outer dome-shaped, internested, and light-transmitting shells definng an enclosed area, said inner shell including air inlet openings adjacent the base thereof and an air discharge opening to said enclosed area, and said outer shell including an air outlet opening adjacent the top thereof; means interposed between said inner and outer shells and maintaining said shells in spaced apart relation, said means including ventilating openings whereby stagnant air is vented from said enclosed area through said air inlet openings, through said ventilating openings, and through said air outlet opening; air supply means;

and baffle means for guiding air from said air supply means, through certain of said ventilating openings, and through said air discharge opening for discharge into said enclosed area.

2. A dome-shaped shelter comprising:

a plurality of blocks having edge walls and light-transmitting opposite walls maintained in spaced relationship by said edge walls, said edge walls having complemental portions interengaged whereby said opopsite walls form an outer dome-shaped shell and an inner dome-shaped shell defining an enclosed area, said edge walls having openings affording communication between said blocks whereby air is circulateable throughout the space between said inner and outer shells, said blocks adjacent the bottom of said inner shell having air inlet openings from said enclosed area, at least one of said blocks above said bottom having an air discharge opening to said enclosed area and at least one of said blocks at the top of said outer shell having an air outlet opening to the exterior of said shelter;

and baffle means disposed in certain of said blocks for guiding air therethrough and out of said air discharge opening.

3. A dome-shaped shelter comprising:

a plurality of blocks having edge walls and light-transmitting opposite walls maintained in spaced relationship by said edge walls, said edge walls having ventilating openings and grooves therein;

and connecting strips disposed in said grooves of adjacent blocks for connecting said blocks together whereby said opposite walls form an outer dome-

shaped shell and an inner dome-shaped shell defining an enclosed area, said ventilating openings in said edge walls affording communication between said blocks whereby air is circulateable throughout the spaces between said inner and outer shells.

4. A dome-shaped shelter comprising:

a plurality of blocks having edge walls and light-transmitting opposite walls maintained in spaced relationship by said edge walls, said edge walls having ventilating openings and grooves therein with narrow throat sections;

and a plurality of flexible, elongated connecting strips each having side portions received in said grooves of adjacent blocks, and having a narrow portion between said side portions received in the associated ones of said throat sections to thereby connect said blocks together whereby said opposite walls form

an outer dome-shaped shell and an inner dome-shaped shell defining an enclosed area, said ventilating openings in said edge walls affording communication between said blocks whereby air is circulateable throughout the spaces between said inner and outer shells.

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