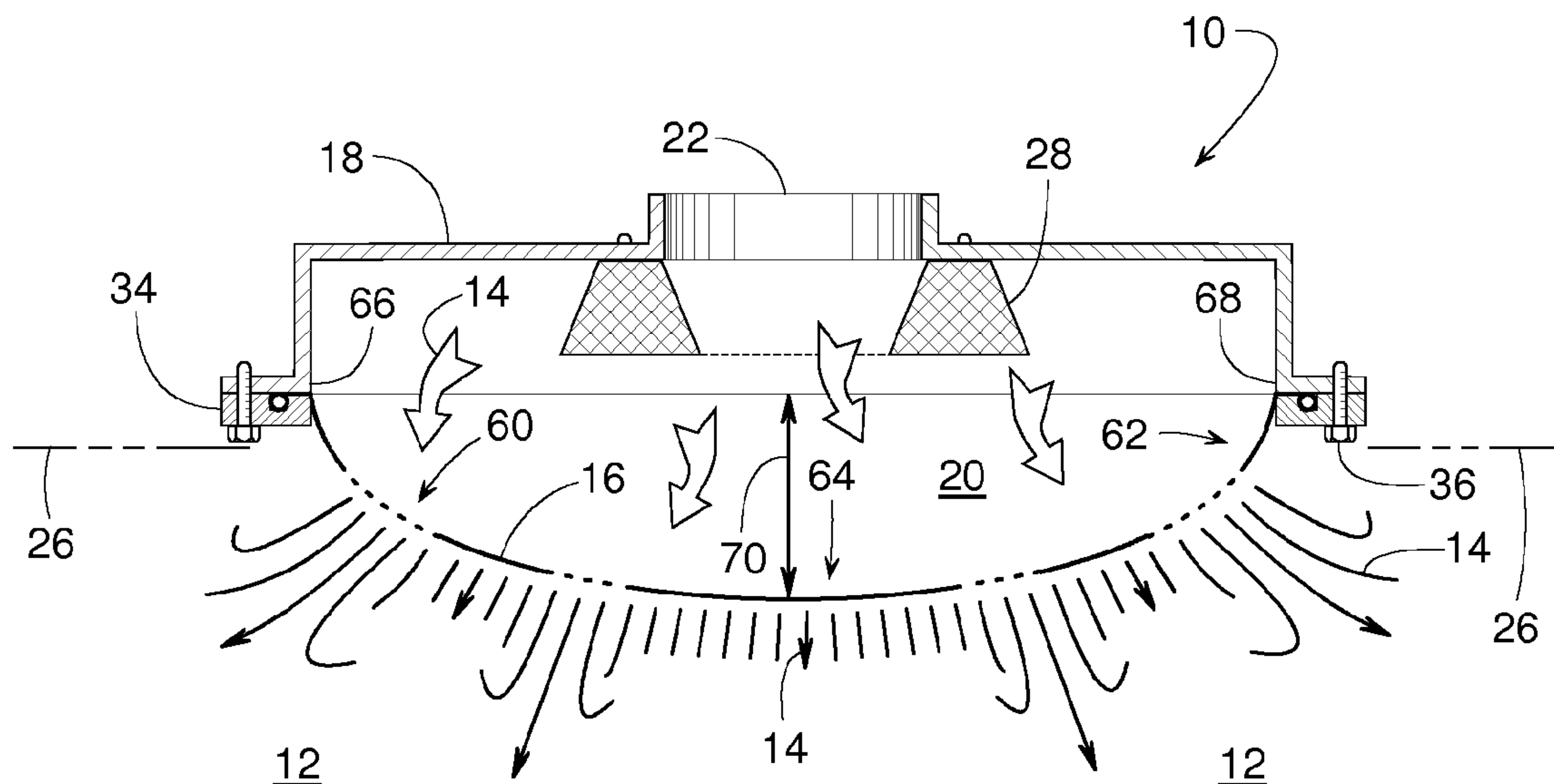




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(54) Title: AIR DIFFUSER AND METHOD FOR CREATING AN AIR DIFFUSER



(57) Abrégé/Abstract:

An air diffuser includes a porous fabric panel having areas of different flow coefficients. The areas' positions and their relative flow coefficients provide a means for not only diffusing the air but also for strategically directing the airflow in a deliberate pattern that promotes intermixing of the air while avoiding adverse air currents. Consequently, the porous fabric itself provides air dispersion and airflow direction without the need for louvers or guide vanes. In some embodiments, the fabric's porosity is programmed by laser cutting small slits into the fabric.



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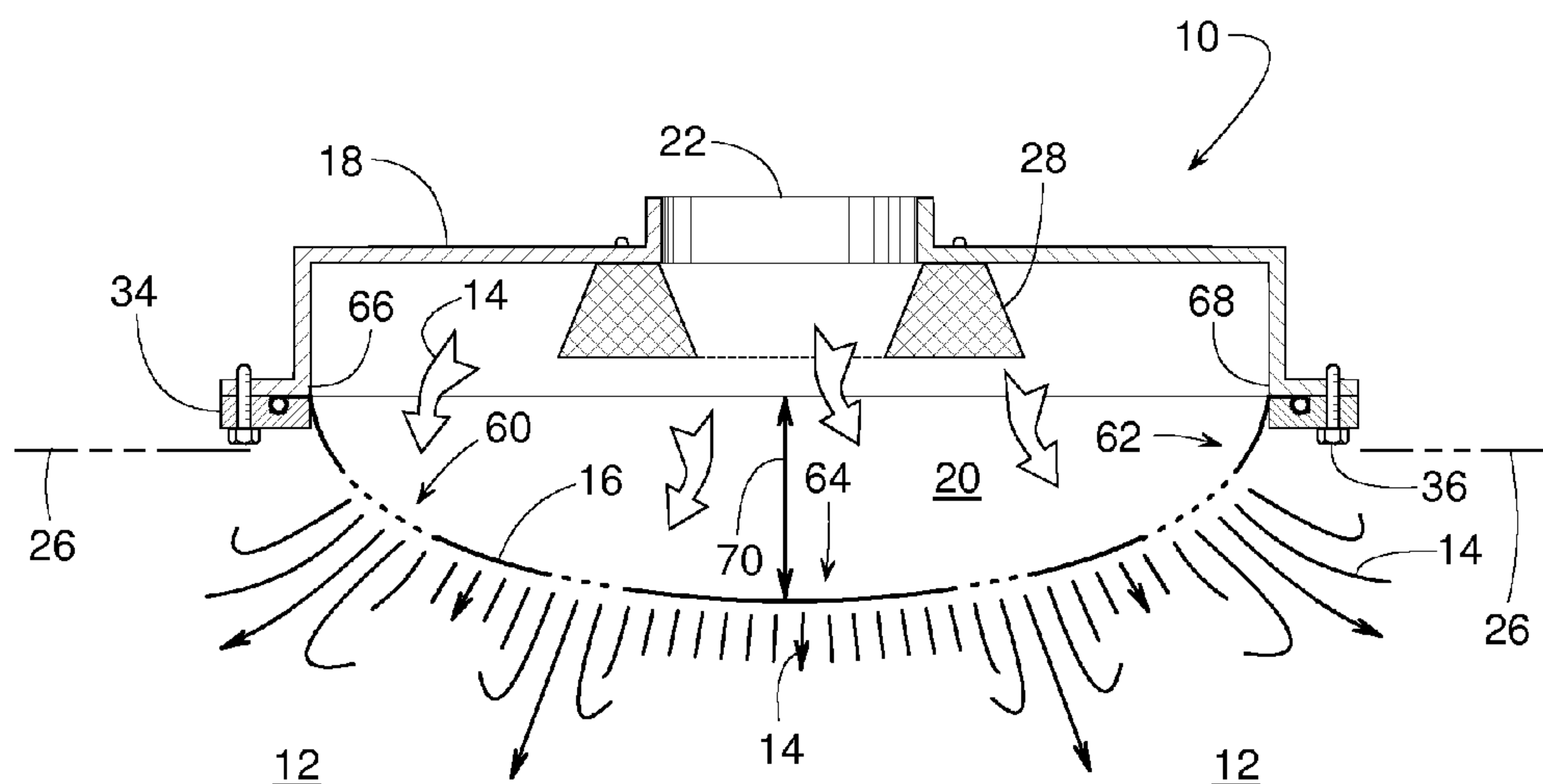
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(54) Title: FABRIC DIFFUSER WITH PROGRAMMED AIRFLOW



(57) Abstract: An air diffuser includes a porous fabric panel having areas of different flow coefficients. The areas' positions and their relative flow coefficients provide a means for not only diffusing the air but also for strategically directing the airflow in a deliberate pattern that promotes intermixing of the air while avoiding adverse air currents. Consequently, the porous fabric itself provides air dispersion and airflow direction without the need for louvers or guide vanes. In some embodiments, the fabric's porosity is programmed by laser cutting small slits into the fabric.

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AIR DIFFUSER AND METHOD FOR CREATING AN AIR DIFFUSER**Field of the Disclosure**

[0001] The patent disclosure generally pertains to discharge air diffusers and more specifically to a fabric diffuser with programmed airflow.

Background of Related Art

[0002] There are a wide variety of air diffusers for directing and dispersing filtered air into a room. A diffuser's ability to properly direct and thoroughly disperse the air is particularly important when the diffuser serves a room that contains a fume hood. A fume hood is an exhaust air register typically used for drawing toxic air from a controlled workstation so that the toxic air does not escape into the rest of the room. Air diffusers replenish the volume of air that the fume hood draws from the room; however, if the diffuser produces adverse air currents, the currents of air might blow or draw the toxic air out from under the fume hood, thereby allowing the toxic air to escape and circulate throughout the room.

[0003] To address this problem, air diffusers often include louvers or guide vanes to direct the airflow in certain directions. In addition to guide vanes, porous materials have been used to evenly disperse the air. Although the combination of guide vanes and porous materials can provide an effective air diffuser, such a combination of elements can add unnecessary cost to the diffuser. Moreover, exposed guide vanes installed downstream of the porous material can be unsightly. Alternatively, guide vanes can be internally installed and hidden by the porous material, but then the guide vanes can be generally inaccessible, which can make it difficult to aim the airflow in a desired direction.

[0004] Consequently, a need exists for a simple yet effective air diffuser that is particularly suited for critical applications.

Summary

[0005] In some examples, an air diffuser includes a porous fabric panel with areas of different porosities.

[0006] In some examples, the fabric panel has some regions with a flow coefficient of between 80 and 320 cubic feet per minute through an area of one square foot at a pressure drop of 0.5 inches of water, and the panel has other regions that have a flow coefficient of between 130 and 500.

[0007] In some examples, the regions of different flow coefficients are adjacent each other to promote intermixing of air therebetween.

[0008] In some examples, a ratio of the first region's average flow coefficient to the second region's average flow coefficient is between 0.3 and 0.9.

[0009] In some examples, a ratio of the first region's area to the second region's area is between one and ten.

[0010] In some examples, the fabric panel covers an area of 3 to 20 square feet such as, for example, about 8 square feet.

[0011] In some examples, the second region includes a plurality of slits each of which has a length and a width, wherein the length is at least three times greater than the width.

[0012] In some examples, the slits are laser cut into the fabric material by feeding the material underneath a pulsating laser.

[0013] In some examples, the slits are substantially parallel to each other.

[0014] In some examples, the diffuser includes a screen that helps break the velocity pressure within the diffuser.

[0015] In some examples, areas of relatively high flow coefficient are biased toward the ceiling to encourage airflow in that area.

Brief Description of the Drawings

[0016] Figure 1 is a bottom view of one example of an air diffuser.

[0017] Figure 2 is a side view of the air diffuser of Figure 1.

[0018] Figure 3 is cross-sectional end view taken along line 3-3 of Figure 1.

[0019] Figure 4 is an exploded view of Figure 3.

[0020] Figure 5 is a perspective view of a screen used in the diffuser of Figure 1.

[0021] Figure 6 is a perspective view illustrating a method of creating an air diffuser.

Detailed Description

[0022] Figures 1 - 3 show an air diffuser 10 that gently ventilates a room 12 by discharging air 14 in a strategic flow pattern. The flow pattern promotes thorough intermixing of the air yet avoids creating deleterious air currents within the room. Air diffuser 10 includes a fabric panel 16 with programmed porosity and other integral features that enable panel 16 to both disperse and direct the air without having to rely on mechanical louvers or guide vanes to do so.

[0023] Basically, fabric panel 16 is attached to and suspended from a back pan 18 to create a plenum 20 between the two. A blower, or some other equivalent air mover, forces air 14 into plenum 20 via an air inlet 22 of back pan 18. The air pressure within plenum 20 may be, for example, between 0.1 and 0.25 inches of water higher than that within room 12 so that the air in plenum 20 forces panel 16 to bulge outward to define a substantially continuous arced surface as shown in Figure 3. To control the shape of the diffuser 10 under pressure (e.g., in a substantially arced shape), diffuser 10 may include two appropriately shaped end panels 24 that connect to fabric panel 16. Although end panels 24 may be made of porous fabric and may be disposed at an incline (relative to ceiling 26) as shown in Figure 2, end panels 24 could alternatively be disposed perpendicular to ceiling 26, be impervious to air, and/or be made of a rigid, non-fabric material. To evenly distribute the air pressure across suspended panel 16, a relatively coarse screen 28 (Fig. 5) may be added to help break the velocity pressure of the air traveling from inlet 22 toward panel 16.

[0024] Diffuser 10 can be assembled as shown in Figure 4. End panels 24 can be sewn or otherwise joined to fabric panel 16. To help attach and suspend panels 16 and 24 from back pan 18, a bead 30 extends along the periphery of panels 16 and 24. Bead 30 fits within a slot 32 in a generally rectangular frame 34, and threaded fasteners 36 can be used to fasten frame 34 to back pan 18, thereby clamping bead 30 between frame 34 and a rim 38 of back pan 18. To hold screen 28 in place, additional fasteners 40 can hold four mounting ears 42 (Fig. 5) of screen 28 to back pan 18. The assembled diffuser 10 may have, for instance, nominal dimensions of two feet by four feet to conveniently fit within a rectangular opening normally meant for receiving standard size ceiling tiles. The total area of fabric panel 16 may be between three and twenty square feet.

[0025] To thoroughly mix and disperse air 14, the example fabric panel 16 includes two or more discrete regions that have different flow coefficients so that diffuser 10 releases air 14

at different flow rates through panel 16, thereby creating an airflow with a predetermined pattern and promoting intermixing of adjacent airstreams. In this manner, the fabric of diffuser 10 can serve the function of both diffusing the air passing therethrough as well as properly separating and directing the airflow. The latter of these functions is conventionally achieved with internal guide vanes or louvers behind a diffuser panel. This conventional structure can be eliminated by giving the diffuser 10 itself areas of differing porosity to thereby separate and direct the airflow to create an airflow of desired pattern. The areas of different porosity can be referred to as having differing flow coefficients. The term, "flow coefficient" refers to a volumetric flow rate through a given area for a given pressure drop. Although the actual units for a flow coefficient may vary, the subject disclosure will be described and claimed using units of cubic feet per minute through an area of one square foot for an industry-standard pressure drop of 0.5 inches of water. The regions of different flow coefficients can be laid out in various locations across panel 16 to program a certain airflow pattern that provides a desired effect.

[0026] Referring to Figure 1, in some examples, panel 16 includes a first region 44 whose flow coefficient is determined by the inherent porosity of the fabric material itself. Panel 16 can be a polyester fabric with a mock leno weave that provides a flow coefficient of 80 to 320, and for example, about 160 cubic feet per minute per unit area at a pressure drop of 0.5 inches of water. A second region 46; comprising areas 46a, 46b, 46c and 46d; has a flow coefficient of 130 to 500, and for instance, about 260 cubic feet per minute per unit area at a pressure drop of 0.5 inches of water. To ensure thorough air dispersion, a ratio of the first region's area to the second region's area may be between one and ten, and a ratio of the first region's average flow coefficient to the second region's average flow coefficient may be between 0.3 and 0.9.

[0027] Referring to Figure 6, the additional porosity or increased flow coefficient of region 46 can be produced in various ways including, but not limited to, laser cutting a plurality of slits 48 into a fabric sheet 50 that can later be used for making panel 16. To create slits 48, a plurality of laser units 52 can be pulsed on and off as sheet 50 is fed across laser beams 54. Good airflow characteristics have been achieved, for example, when each slit is at least three times longer than they are wide. In some cases, each slit is about 1/8 inch long, and the slits are spaced about 1/8 inch apart end-to-end. The slits can run generally parallel to each other and be spaced about 3/16 inches apart from side-to-side. The slits can be grouped to provide areas 46a, 46b, 46c and 46d of different widths. In some cases, for instance, areas 46c and

46d are about 1.5 inches wide (dimension 56), and areas 46a and 46b are about 1.7 inches wide (dimension 58).

[0028] Areas 46a, 46b, 46c and 46d can be positioned on panel 16 to direct a disproportionate amount of air in a first general direction (e.g., horizontally) near ceiling 26, thus avoiding the creation of strong currents of air in a second general direction (e.g., downward) that might disrupt the operation of a fume hood below diffuser 10. To accomplish this, the position of areas 46a, 46b, 46c and 46d can be biased toward a first upper region 60 and a second upper region 62 of panel 16 (Figs. 1 and 3), wherein a central lower region 64 has a relatively low average flow coefficient and regions 60 and 62 have a relatively high average flow coefficient. Regions 60, 62 and 64 are defined as arced portions of the panel 16 each comprising one third of panel 16, wherein first upper region 60 lies along a first lateral edge 66 of rim 38, second upper region 62 lies along a second lateral edge 68 of rim 38, and central lower region 64 is interposed between and adjacent to upper regions 60 and 62.

[0029] The nearly horizontal flow at ceiling 26 may be enhanced when panel 16 droops about 6.5 inches (dimension 70) for a two-foot wide panel as shown in Figure 3. It may also be helpful to have the wider regions 46a and 46b (which are about 1.7 inches wide) close to ceiling 26 and to have the narrower regions 46c and 46d (which are about 1.5 inches wide) a little farther away from ceiling 26.

[0030] Although the invention is described with respect to various examples, modifications thereto will be apparent to those of ordinary skill in the art. For example, the porosity of the first region need not be the same as the native porosity of the fabric - treatment such as coating and/or perforating the material can be used to set its porosity. The shape and location for the areas of different porosity could also be different than those depicted herein - and chosen to achieve a desired airflow patterns or characteristics. For example, while the slits 48 shown on the end panels 24 are parallel to those on the panel 16, they could be perpendicular thereto or disposed at some other angle. Given that such modification are possible without departing from inventive concepts herein, the scope of the invention, is to be determined by reference to the following claims:

Claims

1. An air diffuser, comprising:
a back pan defining an air inlet and a rim;
a fabric panel to be coupled to the back pan to help define a plenum therebetween, the fabric panel includes a first region and a second region that together comprise substantially all of the fabric panel, wherein:
the first region has a first porosity and a first average flow coefficient and the second region has a second porosity and a second average flow coefficient, the first porosity different than the second porosity, the first average air coefficient different than the second average air coefficient; and
a screen to be disposed within the plenum to enable air pressure to be substantially evenly distributed across the fabric panel.
2. The air diffuser of claim 1, wherein the first average flow coefficient is between 80 and 320 cubic feet per minute per square foot of area at a pressure drop of 0.5 inches of water.
3. The air diffuser of claim 1, wherein the second average flow coefficient is between 130 and 500 cubic feet per minute per square foot of area at a pressure drop of 0.5 inches of water.
4. The air diffuser of claim 1, wherein a first area corresponding to the first region plus a second area corresponding to the second region have a combined area of between 3 and 20 square feet.
5. The air diffuser of claim 4, wherein the second area is between 1 and 5 square feet.
6. The air diffuser of claim 1, wherein the second region includes a plurality of slits, each slit of the plurality of slits has a length and a width, wherein the length is at least three times greater than the width.
7. The air diffuser of claim 6, wherein the plurality of slits are substantially parallel to each other.
8. The air diffuser of claim 1, wherein the second region is one of a plurality of second regions, and the plurality of second regions are spaced apart from each other.
9. The air diffuser of claim 1, wherein the rim includes a first pair of opposite edges and a second pair of opposite edges that make the rim generally rectangular, the fabric panel is suspended between the

first pair of opposite edges, the air diffuser further comprises a first end panel and a second end panel that couple the fabric panel to the second pair of opposite edges.

10. The air diffuser of claim 9, wherein the first end panel and the second end panel are made of a fabric.

11. The air diffuser of claim 10, wherein the fabric is porous.

12. The air diffuser of claim 1, wherein the fabric panel is to comprise a substantially continuous arced surface extending across the rim to enable air to disperse from the fabric panel in multiple directions.

13. The air diffuser of claim 1, wherein the first region is to comprise a first arced portion to enable air to radially diverge therefrom in a first general direction and the second region is to comprise a second arced portion to enable air to radially diverge therefrom in a second general direction, the first general direction is different than the second general direction.

14. An air diffuser, comprising:

a back pan defining an air inlet and a rim;

a fabric panel having a first lateral edge and a second lateral edge to be coupled to the rim to help define a plenum between the back pan and the fabric panel, wherein:

the fabric panel includes a first upper region, a second upper region, and a central lower region,

the first upper region has a first porosity and a first average flow coefficient, and the central lower region has a second porosity and a second average flow coefficient, wherein the first average flow coefficient is greater than the second average flow coefficient; and

a screen disposed within the plenum.

15. The air diffuser of claim 14, wherein a first area corresponding to the first upper region, a second area corresponding to the second upper region, and a third area corresponding to the central lower region have a combined area of between 3 and 20 square feet.

16. The air diffuser of claim 14, wherein the first upper region and the second upper region include a plurality of slits.

17. The air diffuser of claim 16, wherein the plurality of slits are substantially parallel to each other.

18. The air diffuser of claim 14, wherein the first upper region is to comprise a first arced portion to enable air to radially diverge therefrom and the central lower region is to comprise a second arced portion to enable air to radially diverge therefrom.
19. The air diffuser of claim 14, wherein the rim includes a first pair of opposite edges and a second pair of opposite edges that make the rim generally rectangular, the fabric panel is suspended between the first pair of opposite edges, the air diffuser further comprises a first end panel and a second end panel that couple the fabric panel to the second pair of opposite edges.
20. The air diffuser of claim 19, wherein the first end panel and the second end panel are made of a fabric.
21. The air diffuser of claim 20, wherein the fabric is porous.
22. A method of creating an air diffuser, the method comprising:
providing a fabric having a first region comprising a first porosity, wherein the first region has a first average flow coefficient;
treating the fabric to create a second region having a second porosity and a second average flow coefficient, the second average flow coefficient is different than the first average flow coefficient;
positioning a screen adjacent a back pan, the screen to enable air pressure to be evenly distributed across the fabric; and
coupling the fabric to the back pan, wherein the back pan defines an air inlet and the fabric and the back pan help define a plenum therebetween providing air flow to the plenum so that air passing through the fabric is diffused while being separated and directed by the first and second regions of different porosity.
23. The method of claim 22, wherein the first average flow coefficient is between 80 and 320 cubic feet per minute per square foot at a pressure drop of 0.5 inches of water.
24. The method of claim 22, wherein the second average flow coefficient is between 130 and 500 cubic feet per minute per square foot at a pressure drop of 0.5 inches of water.

25. The method of claim 22, wherein the first region plus the second region have a combined area of between 3 and 20 square feet.
26. The method of claim 22, wherein the second region is created by laser cutting a plurality of slits in the fabric, where each slit of the plurality of slits has a length and a width, wherein the length is at least three times greater than the width.
27. The method of claim 26, wherein the plurality of slits are substantially parallel to each other.

1/3

FIG. 1

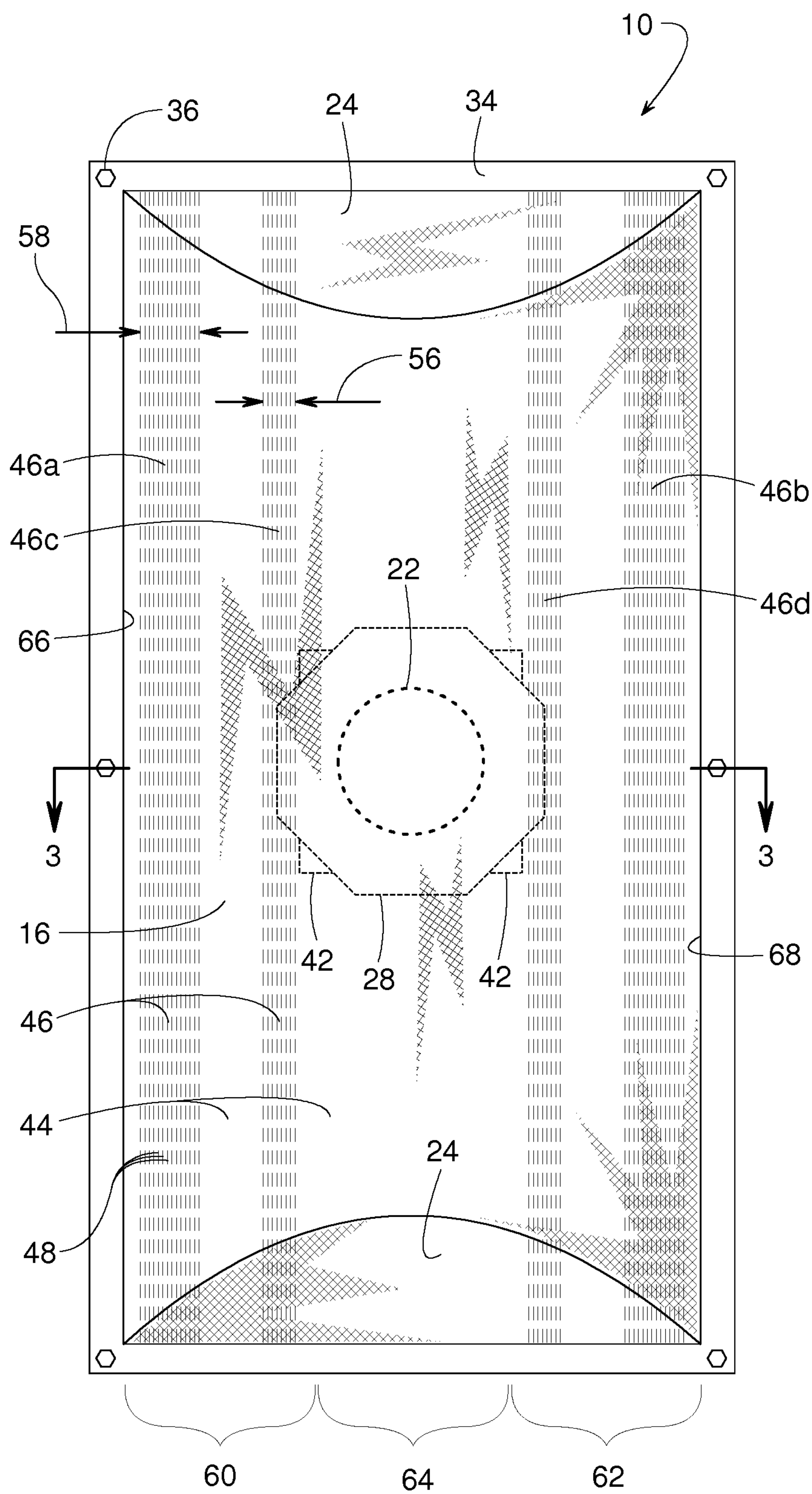
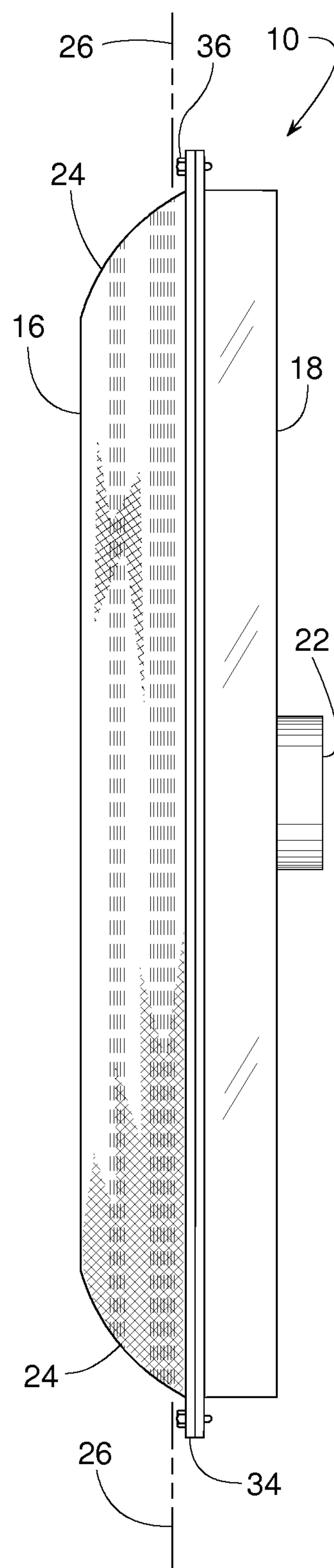


FIG. 2



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FIG. 3

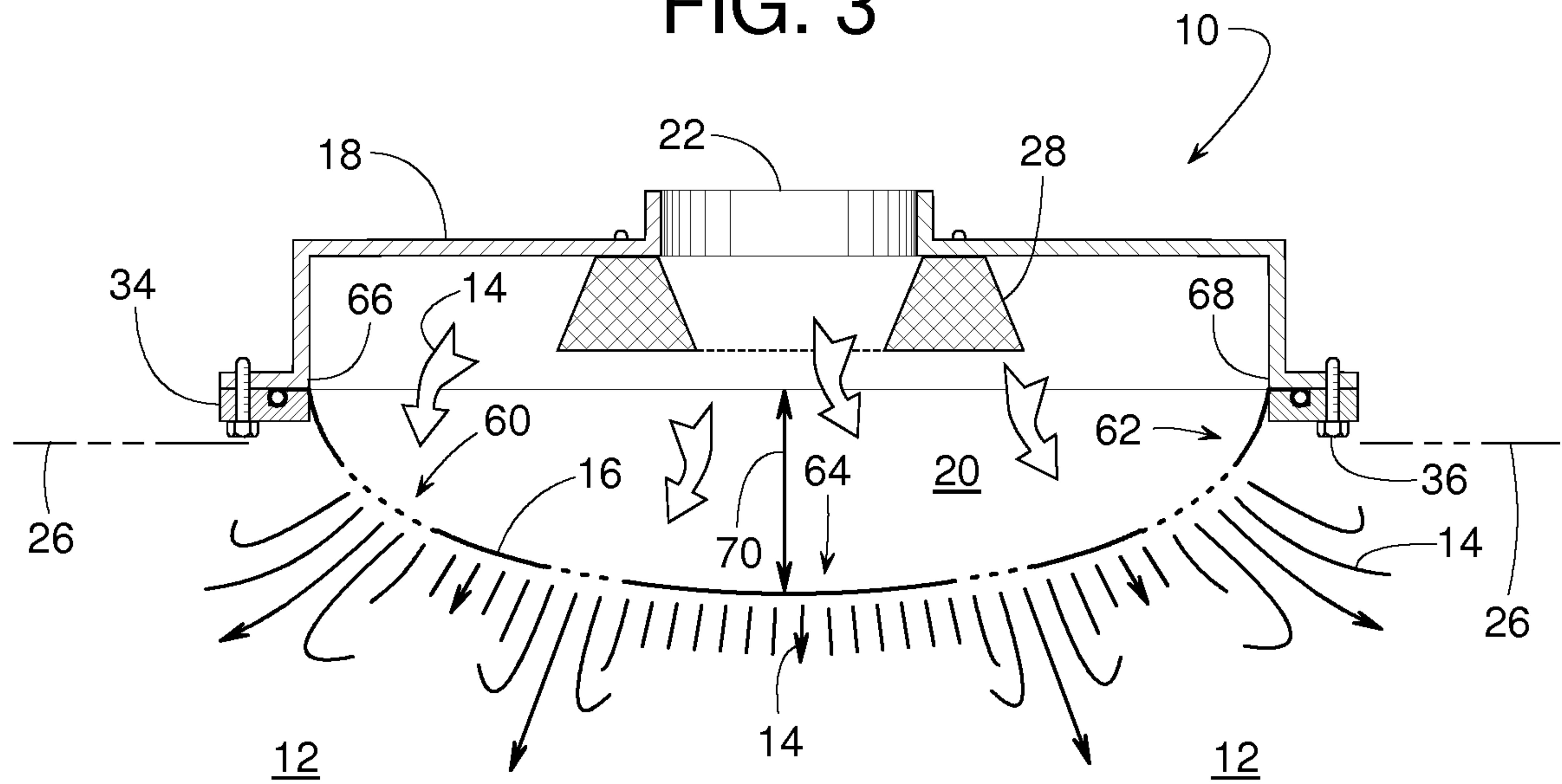


FIG. 4

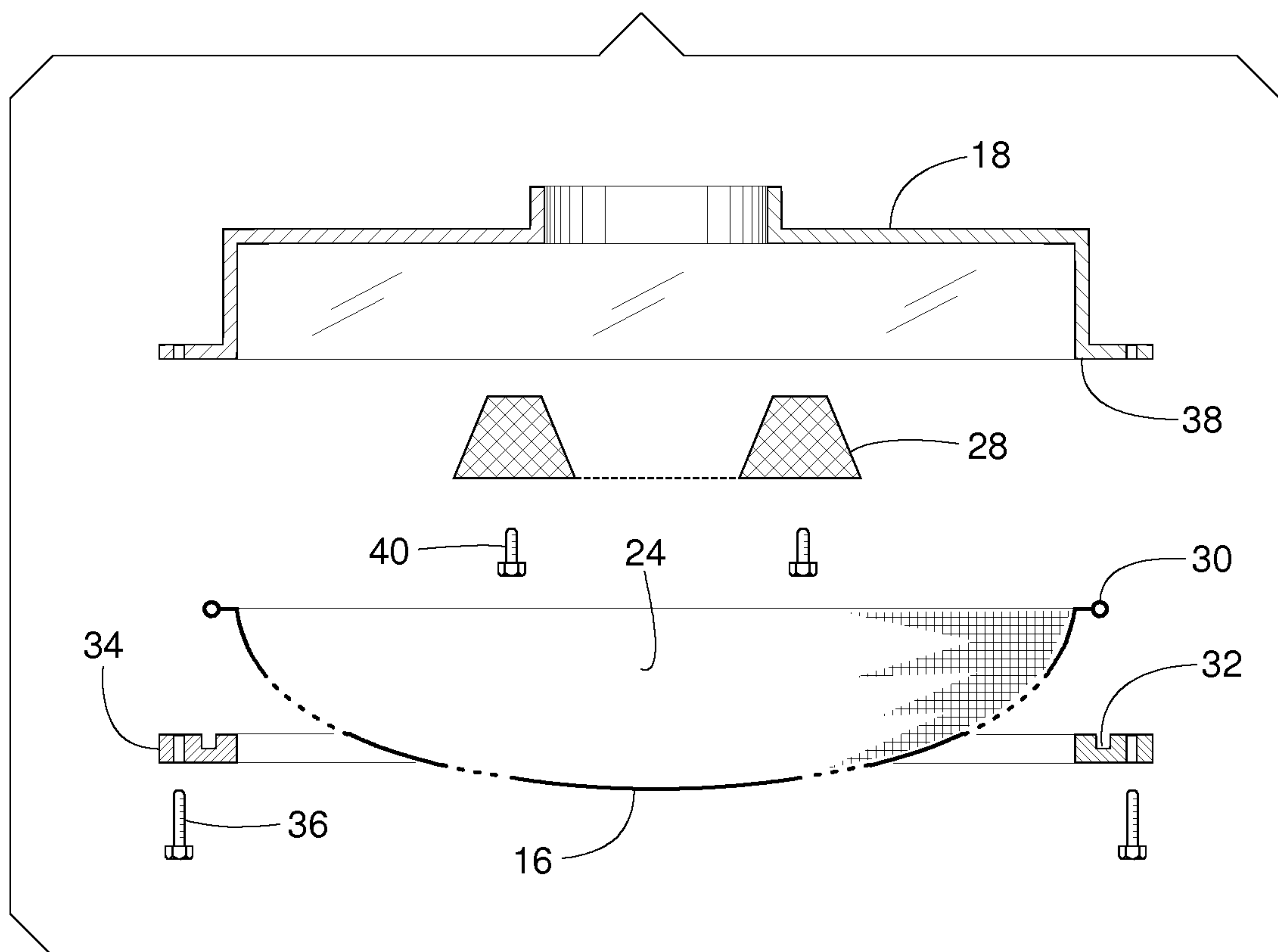


FIG. 5

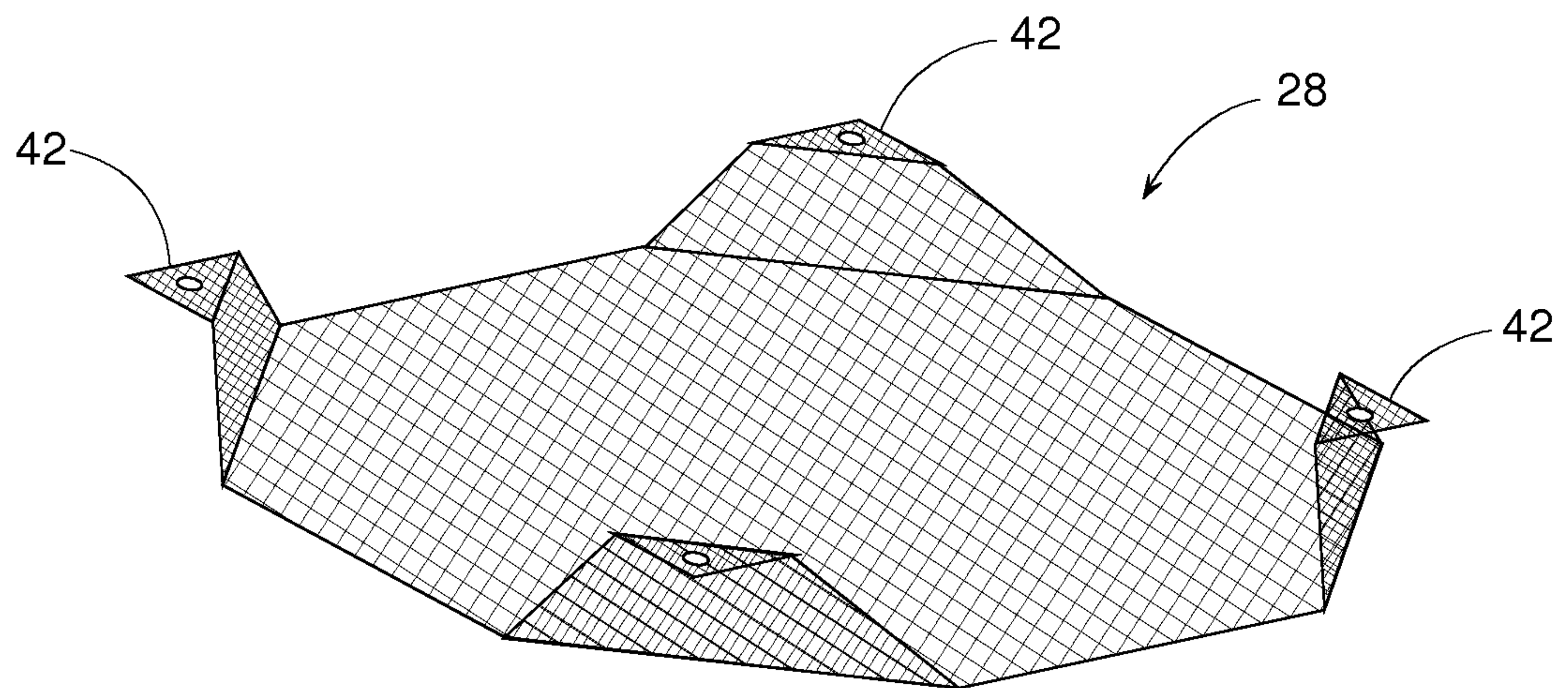


FIG. 6

