United States Patent

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[54] **CLEAN AIR TARGET DEVICE**
5 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **55/97,**
55/473, 55/DIG. 29, 98/36, 98/115 LH
[51] **Int. Cl.** **B01d 46/00**
[50] **Field of Search** ..... 55/97 AC,
270, 279, 482, 485, 467, 470–473; 98/115 LH, 33,
36, 43

[56] **References Cited**

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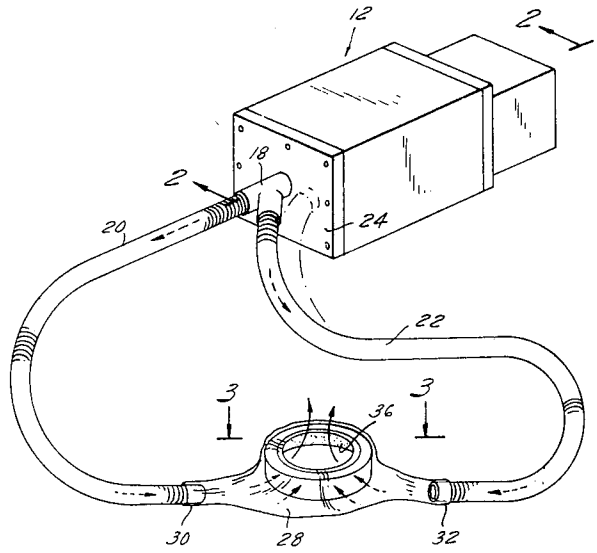
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ABSTRACT: A unit for providing particulate control of a target area comprises means for generating an airflow, means for effectuating a substantially contaminant-free conditioning of said airflow located in the path of said airflow, an annular diffuser having a radially projecting lip on the superior edge of the inner periphery of said diffuser, and an air plenum capable of uniformly directing said conditioned airflow against the outer surface of said diffuser. A method for providing particulate control of a target area comprises generating a decontaminated airflow and directing said airflow uniformly about the outer surface of an annular diffuser, said diffuser having a radially projecting lip on the superior edge of the inner periphery of said diffuser, whereby an object placed within the well of said diffuser is protected from internal and external contamination by a vertically flowing air barrier.

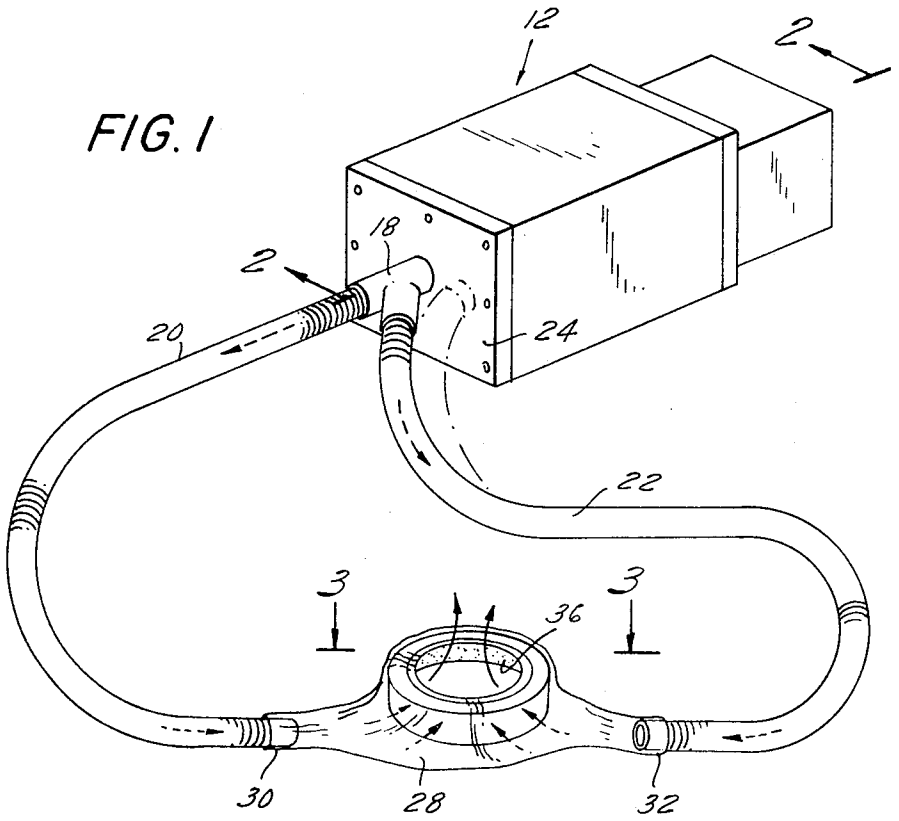


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SHEET 1 OF 3

FIG. 1



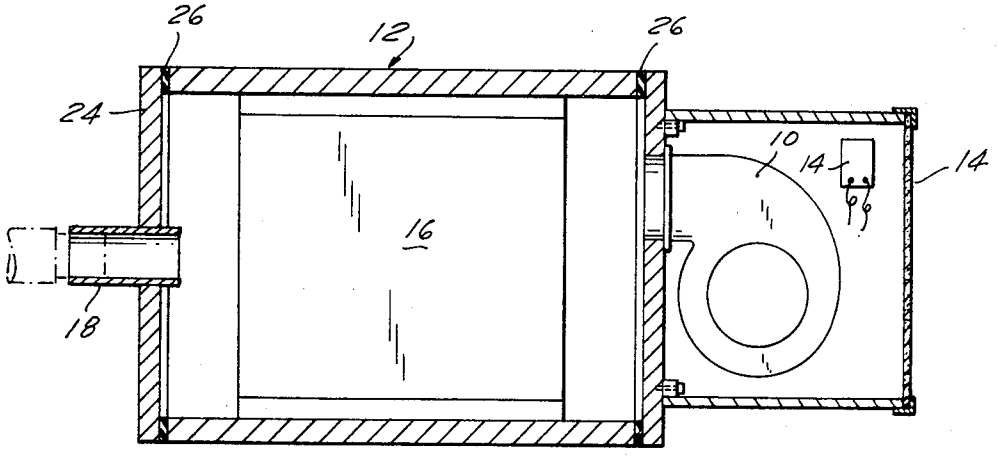


FIG. 2

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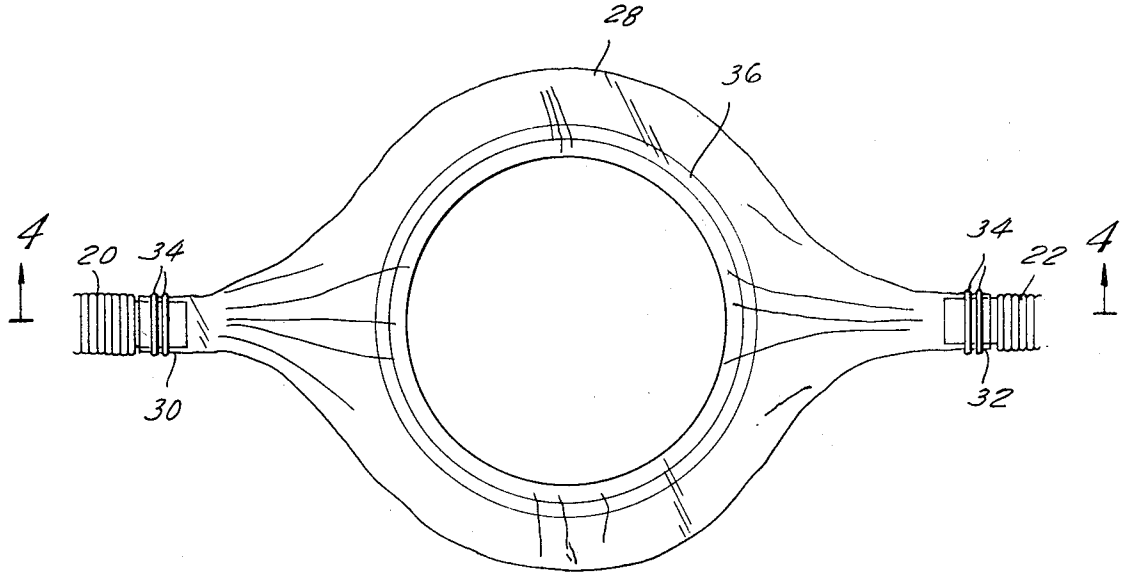


FIG. 3

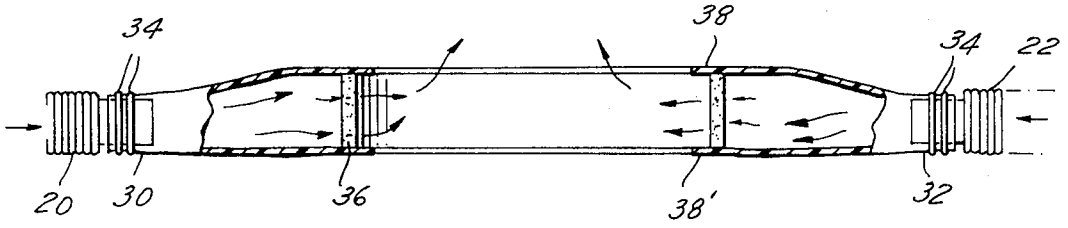


FIG. 4

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FIG. 5

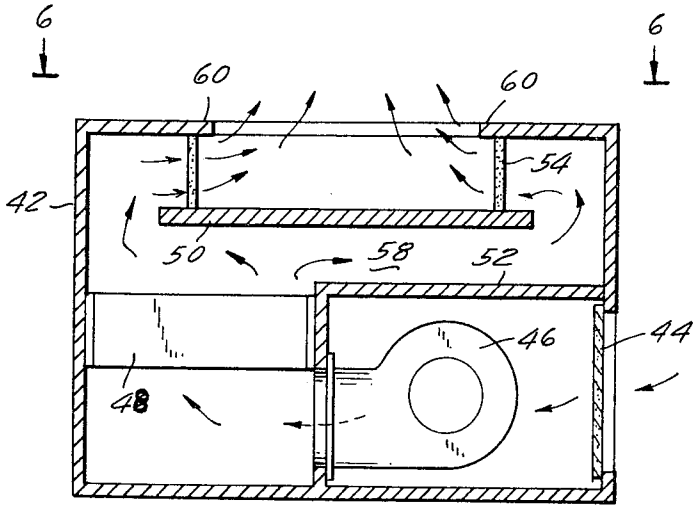
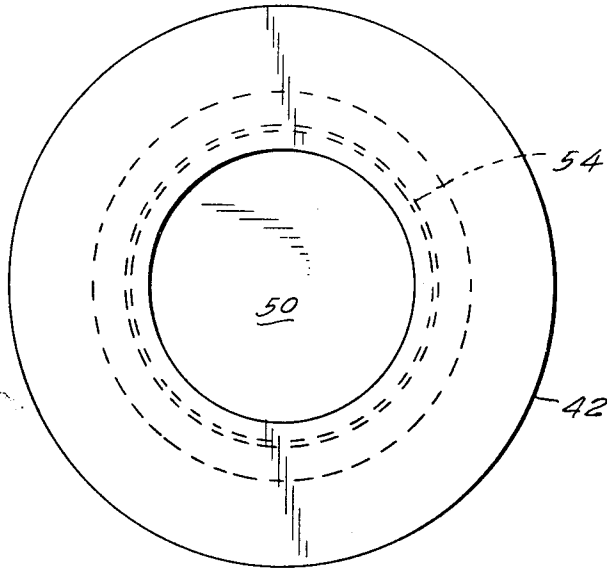


FIG. 6



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CLEAN AIR TARGET DEVICE

BACKGROUND OF THE INVENTION

This invention relates to an apparatus for providing an aseptic air barrier over a target area. In particular, it relates to a versatile device for creating and maintaining a conditioned environment about a preselected area.

Ambient air contains suspended particulate matter including microbial organisms. It has long been a desideratum of industry to provide a means for isolating small objects and/or areas for external contamination by such organisms and other common contaminants such as dust, dirt, and gases. Such areas as an operating field, a cleaning tray or basin employed during the preparation of parenteral solutions, a culture tissue test plate, an area reserved for cleaning and fabricating small precision parts, such as watch parts, miniature bearings, and the like, and others, require the maintenance of a decontaminated atmosphere.

Attempts to provide such an atmosphere for small target areas have been largely unsuccessful. Such devices as laminar flow workbenches and clean rooms are not suitable for small applications as these devices are expensive, unwieldy, and impractical for so small an area.

SUMMARY OF THE INVENTION

It is, therefore, a primary object of this invention to provide a product and process to provide an aseptic barrier over a small target area. It is another object of the invention to provide a small, inexpensive, readily assembled device capable of providing an air barrier to prevent external contamination and for sweeping away locally generated contaminants.

The above and other objects are met by generating a decontaminated airflow and directing said flow uniformly about the outer surface of an annular diffuser, said diffuser having a radially projecting lip on the superior edge of the inner periphery of said diffuser. An apparatus capable of creating an air barrier over a target area to sweep away both locally and externally generated contaminants comprises a means for generating an airflow, means for effectuating a substantially contaminant-free conditioning of said airflow, an annular diffuser having a radially projecting lip on the superior edge of the inner periphery of said diffuser and an air plenum capable of uniformly directing said conditioned airflow against the outer surface of said diffuser.

As highly filtered air passes uniformly through an annular diffuser and into its central well, a rising vortex sweeps away local contamination and prevents aspiration of external contamination. It is an essential feature of the invention that when an object is placed within the well of the diffuser, the uniformly impinging air creates no turbulences behind the object whereby aspiration can occur.

BRIEF DESCRIPTION OF THE DRAWINGS

A device for providing particulate control of a target area is illustrated in the accompanying drawings wherein:

FIG. 1 is a front view, partly in perspective, of a clean air target device of the invention;

FIG. 2 is a horizontal sectional view of an air generating and conditioning portion of the invention taken along a plane corresponding to line 2—2 of FIG. 1;

FIG. 3 is an enlarged, partly fragmentary top view of the invention taken along a plane corresponding to line 3—3 of FIG. 1;

FIG. 4 is an enlarged, partly fragmentary, vertical sectional view taken along a plane corresponding to line 4—4 of FIG. 3;

FIG. 5 is a vertical sectional view of a second embodiment of the invention; and

FIG. 6 is a top view of a second embodiment of the invention taken along a plane corresponding to line 6—6 of FIG. 5.

Referring now to FIGS. 1 through 4, there is illustrated a clean air target device of the invention. Blower 10 situated in housing 12 draws air through prefilter 14 and directs a flow of air through high-efficiency particulate filter (HEPA filter) 16.

An aseptic, essentially contaminant-free airflow is thereby produced.

As illustrated in FIG. 1 the conditioned airflow is directed from chamber 12 to a pair of flexible hoses 20 and 22 via Y-shaped conduit 18. Although hoses 20 and 22 need not be flexible, it has been found that versatility and mobility of this system is enhanced when said hoses are fabricated of flexible material such as flexible vacuum hose.

Y-shaped conduit 18 is mounted in housing cover 24. An airtight seal is provided between housing cover 24 and housing 12 by means of gasket 26 positioned about the inner periphery of cover 24 abutting the inner walls of chamber 12.

The conditioned air is passed through flexible hoses 20 and 22 and into air plenum 28 through diametrically opposed openings 30 and 32. Plenum 28 is constructed of a clear, resilient vinyl film adapted to expand under air pressure within limits as a paper bag or the like would expand under the influence of internal air pressure. In general, other flexible polymeric films may be employed. End portions 30 and 32 of plenum 28 are forced fit over the end portion of hoses 20 and 22. Elastic bands 34, 34 are employed to assist in providing an airtight seal between the hose ends and the plenum.

An annular diffuser 36 is centrally positioned within said plenum. The diffuser is fabricated of a material capable of uniformly directing the conditioned airflow from the plenum into its central well at a velocity sufficient to create an air barrier over the well. For this purpose, the diffuser preferably has the capability of generating an airflow having an upward velocity of from about 60 to 120 feet per minute from its central well, when an airflow impinges its outer surface from the plenum at a flow rate of from about 50 to 200 cubic feet per minute. It is preferred that diffusers employing reticulated materials be employed. Reticulated, flexible foams, particularly a reticulated polyurethane foam having about 45 to 100 pores per square inch provides highly preferred diffuser material.

In order to prevent the immediate expansion of the air as it diffuses into the central well and in order to give direction to the outpouring air from the diffuser, a lip overhang 38 is provided on the superior edge of the inner periphery of the diffuser. For best results, it is preferred that the length of the lip be at least one-sixth of the inner diameter of the diffuser.

Further, in order to ensure that no air is aspirated into the well during operation, it is preferred that the area of the annular diffuser ring is at least as great as the area of the base of the well of the diffuser.

As illustrated in FIG. 3 and 4, the vinyl film plenum is affixed to the inner periphery of the lip. As seen in FIG. 4, a second lip 38' may be employed radially projecting from the base of the diffuser. In this event the vinyl film is affixed to the inner periphery of this lip also. If a second lip is not employed, the vinyl film is affixed by a suitable adhesive or the like to the bottom end 40 of the diffuser.

In operation, air is drawn through prefilter 14 by blower 10 and directed through HEPA filter 16. The conditioned flow is conducted through Y-shaped conduit 18 from the housing into flexible hoses 20 and 22. The flow is thereafter discharged into ends 30 and 32 of plenum 28. Plenum 28 expands under pressure of the conditioned flow. Air from the expanded bag is directed inwardly through the outer surface of the reticulated diffuser. The diffuser expands under the influence of the airflow directed therethrough and discharges a uniform mass of air in a 360° arc towards the center of the diffuser well. As the rushing masses of air collide, they form a vertically rising vortex which provides an air barrier against external contamination and also sweeps locally generated contaminants from any object placed within the well.

In a second embodiment of the invention, each working component of the device is housed within a surrounding chamber. As illustrated in FIGS. 5 and 6, chamber 42 is provided having a circular opening in the top of the chamber. Prefilter 44 provides a primary air intake and blower 46 directs prefiltered air through high-efficiency particulate filter 48

(HEPA) moved in the path of the prefiltered airflow. A gasket seal (not shown) is provided about the edges of the chamber which contact the ends of HEPA filter **48** in order to provide a fully conditioned noncontaminated airflow. A horizontal well surface **50** is positioned within chamber **42** parallel to the plane of HEPA filter **48** and the upper surfaces of an impervious blower mounting **52**. An annular diffuser **54** is positioned on the upper surface of shelf **50** and extending to the top of chamber **42**. Shelf **50** is firmly affixed to the bottom of diffuser **54** and thereby is supported by said diffuser. Diffuser **54** is firmly affixed to the top of housing **42**. Thus, an air plenum **58** is provided within the boundaries of housing **42**, the external surface of diffuser **54**, the lower and side portions of shelf **50** and the top portion of HEPA filter **48** and blower mounting **52**. Diffuser **54** is positioned within chamber **42** such that a portion of the top surface of the chamber overhangs shelf **50**. The overhanging top surface provided a lip **60**.

In operation, air is drawn into chamber **42** by blower **46** through prefilter **44**. Airflow from blower **46** is then directed through HEPA filter **48**, thereby conditioning said flow and removing substantially all microbe-containing particles. From HEPA filter **48** the airflow is directed through plenum **58**, uniformly against the outer surfaces of diffuser **54**. From diffuser **54** air is uniformly directed in a 360° arc inwardly from the inner periphery of said diffuser and inwardly through the opening in the top surface of the housing chamber. Lip **60** on the top of the housing chamber gives the proper direction to the outpouring air and prevents immediate expansion of the air from the diffuser.

Various modifications of the device can increase the versatility of the basic design. For surgical purposes, the complete bag-plenum and annular diffuser could be fabricated as a presterilized, disposable package. By properly selecting the flow resistance characteristics, both the bag-plenum and the diffuser ring could be fabricated of paper. It might also be desirable to form the bottom of the bag-plenum of surgical film, including a continuous film over the bottom of the enclosed target area. An incision could then be made directly through the bottom of the unit for maximum protection from contamination from the surrounding skin area. A surgical tray could be affixed to the outer surfaces of the plenum such that the unit could become an integral part thereof.

A downwardly projecting vortex flow from the device could be employed to bathe the head of an individual in clean irritant-free air, should such individual suffer from pollen irritation. Similarly, the target device could be incorporated to provide a downwardly directed vortex, as by providing a base across the top portion of the well or by employing the device as described in the second embodiment of the invention, to provide environmental protection during the preparation of parenteral solutions or other medications. Similarly, for example, should the device, as illustrated in the second embodiment, be mounted in an upside down position such that the vortex is downwardly created, the unit could be employed in cleaning small precision parts such as watch parts, miniature bearings, and the like. Of course, the units illustrated in FIG. **1** and **6** could be employed to provide and upwardly directed vortex such that precision parts and the like could be cleaned within the well of the diffuser.

In yet another modification, the unit, as illustrated in FIG. **1**, may be employed wherein a single hose directs air to the surrounding plenum. A sealed conduit carrying a liquid or the like could be inserted through the opposite side of the plenum and through the diffuser ring and terminating at the center of the diffuser well. By this innovation, it would be possible to discharge or form a solution by sealing the top of the diffuser well and placing a bottle within the downwardly directed vortex from the diffuser and in communication with the pipe carrying the liquid. An uncontaminated flow of liquid could thereby be introduced into a bottle.

The annular diffuser may itself be fabricated from a filtration media. In this event, the high-efficiency filter **16**, shown in FIG. **2**, is not required.

I claim:

1. Unit for providing particulate control of a target area comprising:

a. a housing,

b. a prefilter positioned in an external wall of said housing,

c. a blower positioned within said housing in communication with said prefilter,

d. a high-efficiency particulate air filter positioned downstream of said blower and located in the path of said airflow from said blower,

e. a resilient film plenum having a pair of diametrically opposed openings,

f. flexible hose means communicating with the discharge end of said high-efficiency particulate air filter and the diametrically opposed plenum openings, and

g. an annular, flexible, reticulated polyurethane foam diffuser having a radially projecting lip on the superior edge of the inner periphery of said diffuser, said diffuser being centrally spaced within said plenum, said plenum being affixed to the superior surface of the lip of said diffuser and extending about the outer surface of said diffuser, terminating at the base of the inner periphery of the lower end of the diffuser ring.

2. Unit for providing particulate control of a target area comprising:

a. means for generating an airflow;

b. filter means for effectuating a substantially contaminant-free conditioning of said airflow connected to and spaced downstream of said airflow-generating means;

c. an air plenum chamber spaced downstream and connected to said filter means for receiving said conditioned airflow; and said chamber having means for forming a vortex comprising

d. an annular porous diffuser forming the inner wall of said chamber comprising:

1. an outer surface in communication with said plenum chamber for receiving said conditioned flow,

2. an inner well providing a target area,

3. an inner surface for discharging said conditioned flow radially inwardly of said target area, and

4. a centrally projecting annular lip on the superior edge of the inner surface of the diffuser, whereby a rising vortex of conditioned air is formed within the target area, said rising vortex sweeping away locally generated contamination from an object placed within the target area and providing a barrier against external contamination within the target area.

3. The apparatus of claim **2** in which the diffuser is fabricated of a resilient, reticulated material.

4. Unit for providing particulate control of a target area comprising:

a. a housing;

b. means spaced within said housing for generating an airflow;

c. filter means spaced within said housing in communication with said airflow-generating means for effectuating a substantially contaminant-free conditioning of said airflow;

d. a resilient film plenum chamber having a pair of openings diametrically opposed;

e. Conduit means connecting the filter means to each of the openings in said plenum chamber for conducting said conditioned airflow to the plenum chamber and said chamber having means for forming a vortex comprising

f. an annular reticulated foam diffuser forming the inner wall of said chamber comprising:

1. an outer surface in communication with said plenum chamber for receiving said conditioned flow,

2. an inner well providing a target area,

3. an inner surface for discharging said conditioned flow radially inwardly of said target area, and

4. a centrally projecting annular lip on the superior edge of the inner surface of the diffuser, whereby a rising vortex of conditioned air is formed within the target area.

5. An integrated, mobile unit for providing particulate control of a target area comprising:

a. a housing having an annular central opening in its upper wall surface,

b. a porous diffuser ring mounted within said housing and projecting axially about said opening, said diffuser ring being affixed to the upper wall surface of said housing such that a portion of the upper surface overhangs the inner periphery of the ring thereby forming an annular lip, said housing having means for forming a vortex with said diffuser ring comprising: being affixed to the upper wall surface of said housing such that a portion of the upper surface overhangs the inner periphery of the ring thereby forming an annular lip, said housing having means for forming a vortex with said diffuser ring comprising:

1. an outer airflow-receiving surface,

2. a central well forming a target area and an inner airflow discharging surface,

c. a flat shelf mounted horizontally within said housing and

extending across the lower ends of the diffuser ring thereby forming a base for the well of said diffuser ring,

d. a high-efficiency particulate air filter mounted within said housing and spaced parallel and upstream of said flat shelf,

e. a blower located within said housing spaced upstream of said high-efficiency particulate air filter, the upper surface of said blower joining the upper surface of said high-efficiency particulate air filter to form a continuous horizontal divider within said housing, and

f. means for introducing air into said blower, whereby air is drawn through said blower, passed through said air filter, received by said outer receiving surface of said diffuser and discharged radially inwardly of said inner surface of the diffuser, thereby forming a rising vortex of air within the target area.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,629,999 Dated December 28, 1971

Inventor(s) Robert Claude Marsh and James Edward Woods

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

At Col. 1, line 9, "desideratum" should be --desiderata--.
line 11, "for" should be --from--.
At Col. 2, line 35, after "having" insert --from--.
At Col. 3, line 1, "moved" should be --mounted--.
line 4, after "well" insert -- - --.
line 6, "surfaces" should be --surface--.
line 17, "The" should be --This--.
line 17, "provided" should be --provides--.
line 25, "inwardly" should be -- upwardly--.
line 58, "and" should be --an--.
line 75, "I" should be --We--.

In the Claims

At Col. 5, line 9 in Claim 5, after "comprising:" delete --being affixed to the upper wall surface of said housing such that aportion of the upper surface overhangs the inner periphery of the ring thereby forming an annular lip, said housing having means for forming a vortex with said diffuser ring comprising:--
At Col. 6, line 1, in Claim 5, "ends" should be --end--.

Signed and sealed this 4th day of July 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
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