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A METHOD AND APPARATUS FOR MINIMISING NOISE
FROM FAN UNIT

FIELD OF THE INVENTION

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The present invention relates to a method and apparatus for minimising noise from air moving devices. In particular, the present invention pertains to a system for reducing noise from a fan unit in a clean room facility.

10 BACKGROUND OF THE INVENTION

It is common for modern production and testing facility to control the particles in the air that circulates within clean room facility in order to ensure the quality of its output. Whether be it wafer dies, compact discs or memory disk drives, effective fan units are needed to not only keep the particle content within the clean room at acceptable levels,
15 but also to circulate the air which the workers breathe.

However, such powerful fan units create excessive noise. It is known to use insulation material to line the conduit to or within the fan units to reduce the noise generated by the fan blowers. Over time, however, the particles or fibres from the insulation material are
20 dislodged from the surface and contaminate the clean room facility.

The problem associated with the particle content in a clean room facility is exacerbated in confined space or enclosures such as a multi-story wafer fabrication plant. By confined space, the present invention envisages the height of the ceiling to be less than three meters. Because of the low height clearance, the noise from fan units is quite pronounced.

OBJECT OF THE INVENTION

It is an object of the present invention to minimise the noise generated by fan units without increasing the particle counts of a clean room facility connected to such units.

It is another object of the present invention to minimise the noise generated by fan units without doing away with the existing fan blower in a confined clean room facility, preferably without any conventional sound insulation material.

SUMMARY OF THE INVENTION

With the above and other objects in mind, the present invention provides a fan unit comprising at least a fan blower disposed on a base plate, a top housing coupled to said base plate with an inlet opening, and side housing coupled to said top housing for enclosing the fan unit, said side housing further having an outlet opening, the fan being for drawing air through the inlet opening and for discharging air through the outlet opening, the fan unit having at least a pair of shaped guides disposed on said base plate within said fan unit and circumferentially of said fan blower for receiving air discharged therefrom; said shaped guides forming a pair of air flow channels having a neck portion

where the air flow channel is of significantly reduced width to create substantially unidirectional air flow in each air flow channel; whereby the flow of air guided is with reduced turbulence compared to a fan unit which does not have the shaped guides, such that noise from said filter unit is minimised without requiring conventional sound
5 insulation material in contact with the air flow path and without introducing contaminants from such sound insulation material into the airflow through the fan unit.

Preferably, there is provided at least a pair of diffusion baffles disposed within the fan unit and at an output of said shaped guides for diffusing the airflow therefrom. There
10 may also be provided at least a pair of guide baffles disposed within said fan unit and adjacent to said diffusion baffles for directing airflow below said base plate. Furthermore, there may be at least one V shaped baffle disposed on the underside of the base plate for evenly distributing the airflow, the flow of air being guided with reduced turbulence compared to a fan unit which does not have the shaped guide, pair of
15 diffusion baffles, pair of guide baffles, and a V shaped baffle.

The shaped guides may be coupled to said base plate with a plurality of clips, and the diffusion baffles may be disposed at an angle of between 30° and 60°, preferably 45°, with the surface of said side housing. The lower edges of the guide baffles may be
20 substantially sloping or substantially straight.

The shaped guides may be substantially S-shaped and have oppositely curved ends. Preferably, one end of each of the shaped guides has a radius of curvature greater than the other end to form a flattened S-shape at the one end. It may even be substantially
25 straight.

One or more of: the diffusion baffles, the guide baffles and the shaped guides may be perforated. Preferably, the perforation may be over a part only or all of each of the baffles and/or guides. The perforations may be covered by a cloth. The guide baffles may
5 be curved.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a exploded, right side, perspective elevational view of the present invention
10 being integrated as part of a fan unit;

FIG. 2 is a front, cross-sectional elevation view of the system of geometric guides and baffles of the present invention together with filter of a fan unit;

15 FIG. 3 is a top, plan elevation view of section A-A in FIG. 2 highlighting the shaped guide and curved baffle of the present invention;

FIG. 4 is a view corresponding to FIG. 3 of an alternative embodiment;

20 FIG. 5 shows the locations in the fan units where the velocities of airflow were measured;

FIG. 6 is a chart comparing the average velocity of airflow of a fan unit with and without the present invention over a range of fan blower power supply (measured in Hz); and

- 5 FIG. 7 is a chart comparing the noise level from a fan unit with and without the present invention and is measured at a location one meter directly below the outlet of the unit.

DESCRIPTION OF THE PREFERED EMBODIMENTS

- 10 A method and apparatus for minimising noise from a fan unit is described. In the following description, numerous specific details are set forth such as guides and baffles, etc. in order to provide a thorough understanding of the present invention. In other instances, well-known parts such as the motors for the fan blower and ducts connected to the fan units are not shown in order not to obscure the present invention.

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- FIG. 1 is an exploded, right side, perspective elevation view of the present invention being integrated as part of a fan unit 10. The fan unit comprises a fan blower 12 disposed within a base plate 14, a top housing 16 and side housings 22 respectively. The fan blower is supported in the base plate by a mounting 20 on the underside of the base plate. Not shown but required for the normal operation of the fan unit 10 is a motor disposed underneath the fan blower 12 for providing rotational movement for the fan blower.
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By itself, the fan unit draws air externally from an air inlet 18 and discharges it via outlet opening 19 as shown in FIG. 2. At the outlet opening may be a filter 32 for removing large particles or contaminants. While the fan unit 10 is effective in circulating or ventilating air in a clean room facility, the noise generated by such unit is annoying. It is a practice in the industry to insulate the fan unit by lining the interior of the fan filter with insulating materials such as sponge, PVC foam, or fibreglass. Unfortunately, over time such insulating materials tend to contaminate the clean room facility as particles from the surface are dislodged and introduced into the airflow through the fan unit. Without the knowledge of the clean room operator, the fan unit becomes a source of contaminants. In the process, the output from clean room facility such as wafer dies, compact discs, or disk drives, is contaminated.

Referring again to FIG. 1, according to the present invention geometric guides are placed in strategic locations within the fan unit to minimise noise from it without contaminating the air flowing through it. Baffles may also be placed along the path of the airflow. The present invention uses at least a pair of shaped guides 24 disposed on either side and circumferentially of the fan blower. A set of diffusion baffles 26 and guide baffles 28 for diffusing and directing air from the shaped guides 24 may also be provided. One or more of the diffusion baffles 26, guide baffles 28 and shaped guides 24 may be porous, if desired. The porosity may be by using perforations; may be partial or complete over the area of the baffles 26, 28 and/or guides 24. Guide baffles 28 may be curved, if desired. There may also be provided a V shaped baffle 30 below the fan blower for distributing air evenly to the filter 20.

FIG. 3 is a top, plan elevation view of section A-A in FIG. 2 highlighting the shaped guides 24. The shaped guides 24 are contoured to receive the discharged air from the fan blower 12 (shown in the dotted circle) and to guide the flow of air with minimum

amount of turbulence towards the diffusion baffles 26. Preferably the shaped guides are made of metallic material whose spring back effect enable the installer to install it easily by inserting it between a plurality of clips 36 disposed on the base plate 14. The guides 24 may be generally "S" shaped as shown in FIG. 3 by having oppositely curved ends 17, 21. If desired, and as shown in FIG 4, each guide 24 may have a flattened "S" shape by having one end 21 of a greater radius of curvature than end 17. Ends 21 may have a varying radius of curvature and may blend relatively smoothly with their respective side walls, as is shown in FIG. 4. The variance in curvature may be to progressively increase the radius of curvature towards the end of ends 21. The ends 21 may be straight, if desired. The embodiment of FIG. 4 gives more open flow characteristics, but gives less control.

The diffusion baffles 26 are at an angle of between 30° and 60°, preferably 45°, to the surface of the side housing. Each baffle 26 may be a sheet of metal, and may have a matrix of holes or perforations over all or part of its surface. In one preferred form of the present invention, the perforations are 3.3 mm in diameter with about 50% spacing. The diffusion baffles 26 are disposed at the angles given above to diffuse the air flowing from the shaped guides 24. Each baffle 26 is preferably a metal plate and, in the form described above, has perforations in it. There is a space 31 behind it. Some of the airflow will contact the metal plate of baffle 26 and be deflected downwardly. Some of the airflow will pass through the perforations. The size of the perforations will determine whether or not the air will slow when passing through the perforations. Due to space 31 behind baffles 26, air pressure in space 31 will increase to be the same as that on the perforations at the strongest part of the airflow. This will force air out through perforations in baffles 26 where the airflow is not as strong. The space 31 may have insulation or other material in it to reduce air turbulence in space 31 and therefore reduce noise. A similar space 37 may be provided behind each shaped guide 24. Space

37 may contain insulation, if desired, particularly if shaped guides 24 are partially or completely perforated.

It is stated above, guide baffles 28 may also be perforated, with the perforations being
5 over all or part of their surfaces. Similarly for guides 24. For baffles 26, 28 and guides 24, if perforated, a cloth covering may be placed over all or some of the perforations to further reduce noise. By using a cloth, the dislodgement and contamination problem is avoided.

10 Adjacent and below the lower edge of the diffusion baffles 26 are disposed the guide baffles 28 for redirecting the flow of air below the base plate. Guide baffles 28 may be straight or, as illustrated, curved. Although the guide baffles 28 can have a straight leading edge, it is preferred they have straight but sloping leading edges 35 as illustrated in FIGS 2, 3 and 4.

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In FIG. 3 the placement of shaped guides 24, the diffusion baffles 26, and the guide baffles 28 are symmetrical to each other with reference to a rotational axis of 180 degrees centred at the fan blower 12.

20 The V shaped baffle 30 is disposed below the fan blower 12 mounting for distributing the air flow evenly before discharging it through the outlet opening 19 of the fan unit 10.

As can be seen, the two shaped baffles 24 create two air-flow channels 23 through which air is moved towards the diffusion baffles 26. The channels 23 have a narrow neck 25 formed by the curve of baffles 24 forming a projection 33 that is significantly closer to (i.e. less spaced from) fan unit 12. The neck 25 creates a constriction on air flow, and thus a high pressure air zone within neck 25. Air will flow from high pressure to low pressure. This therefore forces all air in the neck 25 into the two channels 23 so that the air flow will be strongly unidirectional as air will generally not flow from low pressure to high pressure. This significantly reduces turbulence. As such, noise is significantly reduced, and air-flow efficiency is increased. In FIG. 4 the outlet ends of channels 23 are larger thus giving less control over air flow direction, but increasing air flow efficiency.

FIG. 6 is a chart comparing the average velocity of airflow of a fan unit with and without the present invention over a range of fan blower settings (measured in Hz). The average velocity of airflow is measured at fifteen different points in the fan fitter unit and illustrated in FIG. 5 respectively. Referring to FIG. 6, one can appreciate that the average velocity of a fan unit with the present invention is higher and more even than that without the present invention. It is evident that pressure loss of a fan unit having the present invention is less than that without the present invention. As such, considerable energy saving over time can be achieved.

Finally and most importantly, FIG. 7 is a chart comparing the noise level from a fan unit with and without the present invention and is measured at a location one meter directly below the outlet of the unit. Measured one meter below a fan unit, the present invention allows the fan unit to operate with far less noise than one without the present invention.

While the present invention has been described particularly with reference to FIGS. 1 to 7 with emphasis on a method and apparatus for minimising noise from a fan unit, it should be understood that the figures are for illustration only and should not be taken a limitation on the invention. In addition, it is clear that the method and apparatus of the present invention have utility in many applications where noise reduction is required. It is contemplated that many changes and modifications may be made by one of ordinary skill in the art without departing from the spirit and the scope of the invention as described.

CLAIMS

1. A fan unit comprising at least a fan blower disposed on a base plate, a top housing coupled to said base plate with an inlet opening, and side housing coupled to said top housing for enclosing the fan unit, said side housing further having an outlet opening, the fan being for drawing air through the inlet opening and for discharging air through the outlet opening, characterized in that the fan unit has:
 - at least a pair of shaped guides disposed on said base plate within said fan unit and circumferentially of said fan blower for receiving air discharged therefrom;
 - said shaped guides forming a pair of air flow channels having a neck portion where the air flow channel is of significantly reduced width to create substantially unidirectional air flow in each air flow channel;
 - whereby the flow of air guided is with reduced turbulence compared to a fan unit which does not have the shaped guides, such that noise from said fan unit is minimised without requiring conventional sound insulation material in contact with the air flow path and without introducing contaminants from such sound insulation material into the airflow through the fan unit.
2. A fan unit as in claim 1, wherein there is provided at least a pair of diffusion baffles disposed within the fan unit and at an output of said shaped guides for diffusing the airflow therefrom.

3. A fan unit as in claim 2, wherein there is provided at least a pair of guide baffles disposed within said fan unit and adjacent to said diffusion baffles for directing airflow below said base plate.
- 5 4. A fan unit as claimed in claim 3, further comprising at least one V shaped baffle disposed on the underside of the base plate for evenly distributing the airflow, the flow of air being guided with reduced turbulence compared to a fan unit which does not have the shaped guide, pair of diffusion baffles, pair of guide baffles, and a V shaped baffle.
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5. A fan unit as in any one of claims 1 to 4, wherein said shaped guides are coupled to said base plate with a plurality of clips.
- 15 6. A fan unit as in any one of claims 1 to 5, wherein said diffusion baffles are disposed at an angle of between 30° and 60° with the surface of said side housing.
7. A fan unit as claimed in claim 6, wherein the angle is 45° .
- 20 8. A fan unit as in claim 3, wherein the lower edges of the guide baffles are substantially sloping.

9. A fan unit as in claim 3, wherein the lower edges of the guide baffles between the corners are substantially straight.
10. A fan unit as claimed in claim 3, wherein one or more of: the diffusion baffles,
5 the guide baffles and the shaped guides, are perforated.
11. A fan unit as claimed in claim 10, wherein the perforation is over a part only of the baffles and/or guides.
- 10 12. A fan unit as claimed in claim 10, wherein the perforation is over all of the baffles and/or guides.
13. A fan unit as claimed in claim 11 or claim 12, wherein the perforations are covered by a cloth.
- 15 14. A fan unit as claimed in any one of claims 1 to 9, wherein the shaped guides are substantially S-shaped and have oppositely curved ends.
- 20 15. A fan unit as claimed in claim 14, wherein one end of each of the shaped guides has a radius of curvature greater than the other end to form a flattened S-shape at the one end.

16. A fan unit as claimed in claim 15, wherein the one end of each of the shaped guides is substantially straight.
17. A fan unit as claimed in any one of claims 3, 4 or 8 to 13, wherein the guide baffles are curved.