

## **FAN DIFFUSER SYSTEM**

**This application claims the priority benefit of Taiwan patent application number 102137460, filed on October 17, 2013.**

### **5 BACKGROUND OF THE INVENTION**

#### **1. Field of the Invention:**

The present invention relates to air handling technology and more particularly, to a fan diffuser system, which uses a specially designed diffuser to diffuse the intake flow of air, stabilizing the flow rate of the intake flow of air and enabling the surface air pressure of the intake flow of air to be evenly distributed.

#### **2. Description of the Related Art:**

Clean room air handling systems are commonly used in the semiconductor industry, photonics industry, electronic materials industry, medical device industry as well as biotechnology industry and precision machinery industry for constant temperature and humidity control to improve the yield. Further, due to the reason that people pay more attention to their home environment and personal health, many air handling units have been created for home use to maintain constant temperature and humidity in the rooms of their homes.

Clean room takes an important role in the improvement of

yield in the manufacturing processes of IC and precision industries. In a manufacturing process less than 0.5mm, about 10% of the defective rate is caused by environmental pollution (particle pollution). In a nanometer manufacturing process, the  
5 environmental requirements are critical.

Further, the internal system of a clean room comprises epoxy resin coating, high rise floor, metal panel partition, metal ceiling panel, ultimate filter, wet plate, cold plate, air duct, public system piping, circulating air box, makeup air unit (MAU), etc. The  
10 performance of a makeup air unit (MAU) in a clean room air handling system greatly affects the control of the internal conditions of the clean room. A makeup air unit (MAU) generally comprises a fan unit, cooling water coils, heating water coils (or electrical heater), air filters (for primary filtration, secondary  
15 filtration and high-end filtration), humidifier, air-mixing box, return air duct, and bypass door. The air duct delivers outside air to the return air duct or return air layer in the clean room to mix with the return air, enabling the mixed air to be cooled down through the dry coils and then delivered by the fan unit or fan filter unit (FFU)  
20 to the inside space of the clean room for clean air circulation. The makeup air unit (MAU) in a clean room air handling system is functioned to maintain indoor positive pressure, to remove particles from the intake flow of air, and to control the relative

humidity in the clean room.

However, the fan diffusers of conventional makeup air units commonly have baffles. When the fan unit of a conventional makeup air unit delivers outside air toward the fan diffuser, the baffles of the fan diffuser will baffle the flow of air, causing a wind pressure loss and an increase in the power consumption of the fan unit. Further, the structural design of the baffles does not facilitate uniform distribution of air, leading to flow rate instability, low heat exchange performance, high consumption of chilled (warm) water and low performance of chemical filters in removing micro particles, corrosive odor and polluting chemical gases. In consequence, the gas concentration in the filtered air can be high, sensor detection error can occur easily, and the lifespan of the chemical filter can be shortened to increase the chemical filter replacement frequency. Thus, the conventional designs are neither energy-saving nor cost-effective. An improvement in this regard is needed.

## **SUMMARY OF THE INVENTION**

The present invention has been accomplished under the circumstances in view. It is therefore the main object of the present invention to provide a fan diffuser system, which is practical for a wide range of applications in an energy-saving and cost-effective manner, and can effectively stabilize the flow rate of the intake

flow of air, enabling the surface air pressure of the intake flow of air to be evenly distributed.

To achieve this and other objects of the present invention, a fan diffuser system of the invention comprises a housing defining therein an airflow passage and an air inlet in one end of said airflow passage, a diffuser, which comprises a frame mounted in the airflow passage, a plurality of blades mounted within the frame and longitudinally and transversely intersected and a plurality of vent holes defined by the blades within the frame for diffusing air passing therethrough, and a fan unit mounted in the air inlet of the housing and adapted for drawing outside air into the airflow passage toward the diffuser. Further, the blades of the diffuser are bent outwardly in direction away from the fan unit, each defining a first guide surface and a second guide surface at different angles. Thus, when an intake flow of air goes through the vent holes of the diffuser, the first guide surfaces and second guide surfaces of the blades diffuse the intake flow of air, stabilizing the flow rate of the intake flow of air and enabling the surface air pressure of the intake flow of air to be evenly distributed.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 is a cutaway view of a fan diffuser system in accordance with the present invention.

FIG. 2 is an exploded view of the fan diffuser system in

accordance with the present invention.

FIG. 3 is a front view of the diffuser of the fan diffuser system in accordance with the present invention.

FIG. 4 is a sectional side view of the diffuser of the fan  
5 diffuser system in accordance with the present invention.

FIG. 5 is a schematic sectional view of the present invention, illustrating the air diffusing operation of the diffuser of the fan diffuser system in accordance with the present invention.

FIG. 6 illustrates a performance comparison table obtained  
10 from a test on the diffuser of the present invention and a conventional diffuser.

#### **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

Referring to FIGS. 1-4, a fan diffuser system in accordance with the present invention is shown. The fan diffuser system  
15 comprises a housing **1**, a fan unit **2**, a diffuser **3**, and a pressure drop module **4**.

The housing **1** comprises a body shell **11** defining therein an airflow passage **10** and an air inlet **101** in one end of the airflow passage **10**, and a locating plate **12** transversely and fixedly  
20 mounted in the body shell **11** within the airflow passage **10** and near the air inlet **101** and having a rectangular opening **120** formed therein.

The fan unit **2** is mounted on one side of the locating plate

**12** near the air inlet **101** and facing toward the rectangular opening **120**. Further, the fan unit **2** can be an axial flow fan such as propeller fan, duct fan, vane axial fan or disc fan, or a centrifugal fan for high static air supply application.

5           The diffuser **3** comprises a rectangular frame **31** mounted on an opposite side of the locating plate **12** around the rectangular opening **120**, a plurality of blades **32** mounted within the rectangular frame **31** and longitudinally and transversely intersected, and a plurality of vent holes **30** defined by the blades  
10 **32** within the rectangular frame **31**. Further, the blades **32** are bent outwardly in direction away from the fan unit **2**, each defining a first guide surface **321**, a second guide surface **322** and a bent edge **323** connected between the first guide surface **321** and the second guide surface **322**. Further, the first guide surface **321** and second  
15 guide surface **322** of each blade **32** can be flat surfaces. Alternatively, the first guide surface **321** and second guide surface **322** of each blade **32** can be smoothly arched surfaces.

          Preferably, the first guide surface **321** defines a first bending angle **01** in the range of  $6^{\circ}\sim 30^{\circ}$ ; the second guide surface  
20 **322** defines with the first guide surface **321** a second bending angle **02** in the range of one half to one fifth of the first bending angle. Further, the number of the vent holes **30** is preferably 9x9. Further, the length or width of the vent holes **30** is preferably equal to or

larger than 110mm.

The pressure drop module **4** is mounted in the airflow passage **10** of the housing **1** at one side relative to the diffuser **3** and opposite to the fan unit **2**. Further, the pressure drop module **4** can be a filter module or coil module, comprising a rectangular frame **41** and a plurality of vent holes **40** defined within the rectangular frame **41**. Preferably, the pressure drop module **4** is a filter module selected from the group of chemical filters, aluminum filters, high temperature resistant filters and active carbon filters. Alternatively, the pressure drop module **4** can be a coil module of hot water coils or cold water coils. Further, multiple pressure drop modules **4** can be arranged in parallel in the airflow passage **10** of the housing **1** to meet actual application requirements.

During installation, affix the fan unit **2** to one side of the locating plate **12** near the air inlet **101** to keep the air output side of the fan unit **2** in communication with the rectangular opening **120**, and then affix the rectangular frame **31** of the diffuser **3** to the opposite side of the locating plate **12** around the rectangular opening **120**, and then mount the rectangular frame **41** of the pressure drop module **4** in the airflow passage **10** of the housing **1** at a predetermined distance at a front side relative to the diffuser **3** and opposite to the fan unit **2** to keep the vent holes **40** of the pressure drop module **4** in an orthographically aligned relationship

relative to the vent holes **30** of the diffuser **3**. Further, cold water coils, hot water coils, air filter, humidifier, air-mixing box, return air duct, and/or bypass door can be selectively mounted in airflow passage **10** of the housing **1** at an outer side relative to the pressure drop module **4**.

In application, the fan unit **2** is operated to draw outside air through the air inlet **101** into the airflow passage **10** in the housing **1**, enabling the intake flow of air to be delivered forwardly through the rectangular opening **120** of the locating plate **12** and the vent holes **30** of the diffuser **3** toward the pressure drop module **4**. When the intake flow of air goes through the vent holes **30** of the diffuser **3**, the first guide surfaces **321** and second guide surfaces **322** of the blades **32** diffuse the intake flow of air, stabilizing the flow rate of the intake flow of air and enabling the surface air pressure of the intake flow of air to be evenly distributed. Thus, the power consumption of the fan unit **2** can be relatively reduced, the heat exchange performance of the heating coils (or cooling coils) of the pressure drop module **4** can be relatively improved, the relative humidity level in the clean room can be maintained in the optimal range, the consumption of chilled (warm) water can be significantly reduced, the performance of the chemical filters of the pressure drop module **4** in removing micro particles, corrosive odor and polluting chemical gases can be enhanced, and the lifespan of the

chemical filter of the pressure drop module **4** can be prolonged to reduce the chemical filter replacement frequency can be reduced. In general, the invention is practical for a wide range of applications in an energy-saving and cost-effective manner.

5 Referring to FIG. 6, a performance comparison table obtained from a test on the JJmR diffuser of the present invention and a conventional diffuser in various items including maximum wind capacity, minimum wind capacity, average wind capacity, operating current, operating voltage, operating power, power  
10 consumption per unit amount of wind and power-saving performance per unit amount of wind. In wind capacity, the JJmR diffuser **3** (air diffuser from JJmR Clean-Air Solution Tech. Services Co., Ltd.) shows an improvement about 9% over the conventional diffuser. Further, the power consumption per unit  
15 amount of wind of the fan unit **2** is 0.7864 W/CMH while the power consumption per unit amount of wind of the conventional diffuser is 0.8569, and accordingly, the fan unit **2** is able to provide 8.23% power-saving performance per unit amount of wind.

Although a particular embodiment of the invention has been  
20 described in detail for purposes of illustration, various modifications and enhancements may be made without departing from the spirit and scope of the invention. Accordingly, the invention is not to be limited except as by the appended claims.

**What the invention claimed is:**

1. A wind diffuser system, comprising a housing defining therein an airflow passage and an air inlet in one end of said airflow passage, a diffuser mounted in said airflow passage and  
5 adapted for diffusing air passing therethrough, and a fan unit mounted in said air inlet of said housing and adapted for drawing outside air into said airflow passage toward said diffuser, wherein said diffuser comprises a frame mounted in said airflow passage, a plurality of blades mounted within said frame and longitudinally  
10 and transversely intersected, and a plurality of vent holes defined by said blades within said frame, said blades being bent outwardly in direction away from said fan unit, each said blade defining a first guide surface and a second guide surface at different angles;

wherein each said blade further comprises a bent edge  
15 connected between said first guide surface and said second guide surface; said first guide surface defining a first bending angle, said second guide surface defining with said first guide surface a second bending angle in the range of one half to one fifth of the first bending angle; and

20 wherein said first bending angle is preferably in the range of  $6^{\circ}$ ~ $30^{\circ}$ .

2. The wind diffuser system as claimed in claim 1, wherein said housing comprises a body shell surrounding said airflow

passage, and a locating plate transversely and fixedly mounted in  
said body shell within said airflow passage and near said air inlet,  
said locating plate defining therein an opening; said fan unit is  
fixedly mounted on one said of said locating plate near said air  
5 inlet and facing toward said opening of said locating plate; a  
rectangular frame of said diffuser is fixedly mounted on an  
opposite side of said locating plate around said opening of said  
locating plate to keep the vent holes of said diffuser in air  
communication with said opening of said locating plate and said  
10 fan unit.

3. The wind diffuser system as claimed in claim 1, wherein  
said first guide surface and said second guide surface of each said  
blade are flat surfaces or smoothly arched surfaces.

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