Clean Air Apparatus

~~The invention~~Various embodiments relates to clean air apparatuses, and particularly, although not exclusively, to clean air apparatuses which can be used in operating theatres, and in manufacturing plants of any product requiring a "clean room" environment, such as pharmaceutical products or semiconductors.

In the manufacture of many products, such as pharmaceuticals and semiconductors, there is a need to maintain the working environment as clean as possible in order to reduce the possibility of the product becoming contaminated. Furthermore, in a hospital operating theatre, it is important that the area surrounding at least the operating table supporting the patient is kept as sterile as possible in order to reduce the risk of infection.

Clean air systems which harness the so-called Coanda effect in order to create a jet or curtain of clean air over a designated target clean area are known. The Coanda effect is the tendency of a fluid jet to be attracted to a nearby surface, and is caused by the entrainment of ambient fluid around the fluid jet. When a nearby surface does not allow the surrounding fluid to be pulled inwards towards the jet (i.e. to be entrained), the jet moves towards the surface instead.

However, a problem with known Coanda-based clean air systems is that they are unable to efficiently direct the clean air Coanda jet towards the target clean air zone, such as an operating table or pharmaceutical or semiconductor manufacturing area. This results in the clean (i.e. filtered) air mixing with surrounding unclean (i.e. unfiltered) air, which is then entrained into the target clean air zone, thereby causing infection and contamination.

Accordingly, there is a need to provide an improved clean air apparatus.

According to a first aspect ~~of the invention~~, there is provided a clean air apparatus comprising clean air means for producing a flow of clean air and for discharging the clean air from an outlet and towards a target clean area, a Coanda effect device disposed at least adjacent the clean air means and arranged, in use, to induce a Coanda effect upon the flow of clean air, and guide means for guiding the clean air towards a target clean area in the form of an air curtain.

In a second aspect, there is provided a method for discharging clean air towards a target clean area in the form of an air curtain, the method comprising:-

(i) creating a flow of clean air by clean air means;

(ii) discharging the flow of clean air through an outlet;

(iii) inducing a Coanda effect upon the flow of clean air using a Coanda effect device disposed at least adjacent the clean air means; and

(iv) guiding the discharged clean air towards a target clean area in the form of an air curtain.

Advantageously, the provision of the guide means ensures that the Coanda air is more efficiently and accurately directed in the form of an air curtain towards the target clean area. Preferably, the guide means is adapted to create an air curtain around the periphery of the clean area. The outer periphery of the target clean area preferably comprises air which is travelling at an increased speed compared to that of the clean air inside the target clean area. As such, the air curtain provides improved protection to the clean (i.e. filtered) air present in the target clean area. This is achieved by preventing the clean air in the clean area from mixing with unclean surrounding air, which may be unfiltered, thereby avoiding the risk of contamination.

In one embodiment, the clean air apparatus may be used in a hospital operating theatre in order to maintain sterile conditions. For example, the apparatus may be incorporated into a hospital's ultra clean ventilation (UCV) system, which may be installed in an operating theatre. In this embodiment, the clean air means may comprise or be part of the UCV system.

Thus, in a third aspect, there is provided a hospital ultra clean ventilation (UCV) system comprising the clean air apparatus according to the first aspect.

The UCV system may be installed in a hospital operating theatre. The clean air apparatus may be disposed above an operating table on which a patient undergoing an operation may be supported. Advantageously, the inventors have shown that the apparatus of the ~~invention~~ disclosure can be used in a canopy without any partial walls present such that it can be installed at a high level. Accordingly, the creation of the air curtain by the apparatus of the ~~invention~~ disclosure replaces screens or partial walls, which would otherwise be required, for example in an operating theatre.

In use, the apparatus may be installed at a minimum height of about 2300mm, 2500mm or 2700mm above the target clean area, which may be an operating table. The apparatus may be installed, in use, at a maximum height of about 2900mm above the target clean area. However, it will be appreciated that the height at which the apparatus is installed is dependent on the specific application and environment.

Alternatively, in another embodiment, the clean air apparatus may be used in a manufacturing plant of any product requiring a "clean room" environment, such as the manufacture of a pharmaceutical product or a semiconductor.

Hence, in a fourth aspect, there is provided a pharmaceutical manufacturing plant ventilation system comprising the clean air apparatus according to the first aspect.

In a fifth aspect, there is provided a semiconductor manufacturing plant ventilation system comprising the clean air apparatus according to the first aspect.

The Coanda effect device is capable of inducing the Coanda effect upon the flow of clean air. It will be appreciated that a "Coanda effect" arises when a tangential jet of air moves passed a convex surface. The jet of air exhibits strong attachment to the surface and is deflected from the tangential direction to follow the profile of the curved surface. By using the Coanda effect device in conjunction with the clean air apparatus of the ~~invention~~disclosure, the deflected jet of air entrains a portion of the adjacent clean air and produces an outwardly-directed flow of air out of the outlet which can be controlled and directed by the guide means as an air curtain towards at least the periphery of the target clean area. Any potentially contaminating or unclean air must therefore overcome the outward flow of clean air in order to reach the target clean area, and the likelihood of contamination of the clean area by unfiltered air is thus significantly reduced or even abolished. If the tangential jet of air produced by the Coanda effect device is also clean air, then the effect is to enlarge then target clean area.

In one embodiment, at least a part of the periphery of the outlet may be provided with the Coanda effect device. In a preferred embodiment, however, substantially all of the periphery of the outlet is provided with the Coanda effect device.

All of the features described herein (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined with any of the above aspects in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

For a better understanding of the ~~invention~~disclosure, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:-

Figure 1 is a cross-sectional side view of first and second embodiments of a clean air apparatus in accordance with the invention. On the left-hand side, there is shown an embodiment of a passive Coanda effect apparatus, and on the right-hand side, there is shown an embodiment of an active Coanda effect apparatus;

Figure 2 is an inverted plan view of the two embodiments of the clean air apparatus shown in Figure 1, with the passive Coanda apparatus represented in the left-hand side, and the active Coanda apparatus shown on the right-hand side;

Figure 3 is an enlarged cross-sectional side view of the passive Coanda effect apparatus shown in Figure 1;

Figure 4 is an enlarged cross-sectional side view of the active Coanda effect (with internal blowing) apparatus shown in Figure 1;

Figure 5 is an enlarged cross-sectional side view of the active Coanda effect apparatus shown in Figure 4 illustrating the angle of a guide vane; and

Figure 6 is an enlarged cross-sectional side view of a third embodiment of the clean air apparatus (i.e. active Coanda with external blowing).

Examples

Referring to Figure 1, there are shown first and second embodiments of a clean air apparatus 2, 4. For the avoidance of doubt, apparatus 2, 4 correspond to the same Ultra Clean Ventilation [UCV] system 6 which is secured to a ceiling 8 above a target clean area 12. The apparatus 2, 4 can be used in any environment or room where there is a need to create a "clean air" environment, for example over an operating table 10 in an operating theatre, or in a pharmaceutical or semiconductor manufacturing plant over the location where the pharmaceutical ingredients or semiconductor components are mixed together.