

HYPOXIC CLEANROOM SYSTEMS FOR INDUSTRIAL APPLICATIONS

RELATED APPLICATIONS

This invention is a continuation in part and improvement of preceding patent applications of Igor K. Kotliar:

Ser. No. 08/445,677, "Apparatus for hypoxic training and therapy", filed May 22, 1995;

Ser. No. 08/505,621, "Hypoxic Room System and equipment for hypoxic training and therapy", filed Jul. 21, 1995;

Ser. No. 08/739,379, "Hypoxic flow system for individual active and passive hypoxic training", filed Oct. 29 1996;

Ser. No. 08/797,242, "Apparatus for passive hypoxic training and therapy", filed Feb. 8, 1997.

FIELD OF THE INVENTION

The present invention relates to a process and equipment for providing a low-oxygen (hypoxic) cleanroom environment for industrial applications.

The demand in clean room applications has been growing extensively in last years, especially for cleanrooms with a low oxygen content. Manufacturers of semiconductors and some other electronic and optical components, pharmaceutical and medical packaging companies, health care facilities, food processing, packaging and storage companies and many other industrial branches are looking today for clean, low-oxygen environment systems in order to increase the quality of their products and services.

DESCRIPTION OF THE PRIOR ART

At the present time many manufactures, mainly in semiconductor- and medical packaging industries, are forced to use services of nitrogen-gas suppliers to low oxygen content in their production cleanrooms or have to move their facilities to highlands.

Most commonly used method for providing a low-oxygen environment inside a cleanroom is pumping a nitrogen into it. This method is inconvenient and costly, and makes production process dependent from a gas availability. Moreover, nitrogen exiting cleanroom contaminates surrounding environment in the production facility requiring higher ventilation and/or air-conditioning costs.

Some low-oxygen or oxygen-free cleanrooms for automated production have to be hermetically sealed and are not easy accessible for servicing.

SUMMARY OF THE INVENTION

A principal object of this invention is to provide a method for producing an oxygen-depleted (or oxygen-free) environment inside a cleanroom.

Another object of the present invention is the provision of an oxygen-depletion process inside a cleanroom or other enclosure which employs pressure-swing adsorption air-separation equipment.

A further object of the present invention is the provision of an oxygen-depletion process inside a cleanroom or other enclosure which employs membrane air-separation equipment.

A still further object of the invention is to provide an oxygen-depleted cleanroom environment inside an enclosure at normal atmospheric or increased pressures.

A still further object of the invention is to provide an easily-accessible hypoxic cleanroom which does not need to be sealed from the surrounding environment.

Yet another object of the present invention is to provide a safe and environmentally-friendly hypoxic cleanroom which does not change the air composition in the surrounding environment.

Still another object of the present invention is the provision of a hypoxic cleanroom with controllable temperature and humidity.

A yet further object of the invention is to provide oxygen-depletion equipment which can produce filtered, sterile gas mixtures in order to provide hypoxic cleanroom environments from class 1000,000 up to class 0.1 and with a nitrogen content up to 99.99%.

A still further object of the invention is the provision of hypoxic cleanrooms having one, two or more anterooms, which allows frequent traffic and considerably reduces circulated air flow in order to save energy and the life of filters.

A still further object of the invention is to provide easily-accessible normbaric hypoxic microenvironments for people to work in safely without respiratory-support means, having an oxygen content from 14 to 15% which corresponds to the air composition at altitudes of 8,000 to 9,000 feet.

A still further object of the invention is to provide cleanrooms with an extremely low oxygen content (up to 0.05%), easily accessible with respiratory support devices.

A still further object of the invention is to provide cost-effective, easy-to-install, environmentally-friendly hypoxic cleanroom systems which can be used in a variety of industrial applications, including: microchip and semiconductor production, medical packaging, food processing, packaging and storage, health care, storage and/or transportation of inflammable and explosive materials, etc.

A yet further object of the invention is to provide a hypoxic gas recirculation system which can provide a sufficient flow of hypoxic gas mixture inside a cleanroom in order to produce stable laminar flow in desired direction and of desired flow rate; said system substantially extending the life of filtering devices.

Yet another object of the present invention is to provide a hypoxic gas recycling system which allows to use less energy and substantially extend life of filters and compressors.

A still further object of the present invention is to provide systems with low-oxygen or oxygen free environments for use in transportation and storage containers including food refrigerating enclosures.

Among the many advantages of the invented system is the complete elimination of costly nitrogen gas storage and supply. The invented system takes nitrogen from the surrounding environment but does not affect the surrounding air composition at all, because the same amount of nitrogen is constantly returned into the surrounding atmosphere.

Working in a simulated high-altitude environment will provide the benefits of "hypoxic training" effect described in preceding patent applications. This means that people working in hypoxic environments will get healthier resulting in substantial savings in health care and insurance costs.

Food processing, packaging and storage facilities could reduce their refrigeration costs and provide better quality of their products and packaging. Any grocery or flower shop could convert their storage room into a clean hypoxic environment and save on refrigeration.

A big advantage of hypoxic cleanrooms is that they are fully climate-controlled, which is important for many applications, and do not require huge quantities of air for