

AIR STERILISATION

DESCRIPTION

- This invention relates to the sterilisation of air and is based upon the effect caused by the passage of a continuous air flow through a set of small diameter ducts, in which energy is dissipated by Joule effect.
- 5 The high thermal gradient produced in the inside of such ducts has an average value of 220°C and, therefore, it is capable of destroying the protein membrane of most of the bacteria and virus found in air.
- 10 The thermal effect as a sterilising agent is largely used and universally known in the same way that the Joule effect is known as a heating source.
- The present invention introduces as a novel approach the employment of high thermal gradient ducts which enhance the sterilising action of the Joule effect, thus improving its efficiency concerning the destruction of micro-organisms present in the air, without causing noticeable ambient-air temperature alteration in rooms where the inventive arrangement is
- 15 installed.
- 20 The underlying technical-scientific principles on which the invention relies are the laws of thermodynamics, in particular, the convection of gases through axially-heated ducts of small diameter.
- 25 The invention has a wide variety of applications, such as those which require indoor elimination of micro-organisms found in air and/or modification of the relative humidity of air, without causing considerable change in the ambient temperature.
- 30 Also, the inventive apparatus can be built to suit any air volume, because there exists a very well defined correlation between volume and power of the apparatus.

Accordingly, one aspect of the present invention provides an air sterilisation apparatus comprising a refractory block having a top and bottom, a plurality of vertically disposed ducts extending through said block from said bottom to said top, said ducts including top and bottom ends and said duct ends communicating directly with ambient air, resistive heating elements disposed within said ducts, and means supplying electrical energy to said heating elements to produce a thermal gradient in said ducts, whereby ambient air is drawn into and upwardly through said ducts solely by convection with minimal increase in temperature of the ambient air due to said air issuing from said ducts.

Another aspect of the invention provides a method of air sterilisation using a refractory block having a top and bottom, a plurality of vertically disposed ducts extending through said block from said bottom to said top, said ducts including top and bottom ends and said duct ends communicating directly with ambient air, resistive heating elements disposed within said ducts, and means supplying electrical energy to said heating elements to produce a thermal gradient in said ducts wherein ambient air is drawn into and upwardly through said ducts solely by convection with minimal increase in temperature of the ambient air due to said air issuing from said ducts.

Nowadays, several methods are employed to achieve air sterilisation in places where micro-organisms proliferation is high. The most common methods are:

the direct use of Joule effect by simple heating, which does not present any thermodynamic improvement, thus exhibiting low efficiency as far as the sterilisation effect is concerned;

the use of incandescent bulbs, which can be considered as encompassed by the previous method since the thermal effect stems from the bulbs; and

5 the use of ultra-violet radiation in flow-forced air chambers.

The advantages of the present invention in relation to the above-mentioned known processes are as follows:

10 increase in the efficiency in terms of sterilised volume/watt which is due to the high thermal gradient ducts with axial heating;

simplicity of the heating process, since high efficiency is attained by a proper choice of the duct parameters according to the laws of thermodynamics; and
15 protection is afforded against short-circuits by means of a suitable fuse and no considerable increase in the ambient-air temperature is observed.

According to some measurements taken in prototypes of the invention apparatus functioning at an
20 ideal operation point, a consumption of 5 watt.hour/cubic meter was observed, leaving the air with a negligible amount of micro-organisms.

When these results are compared with those associated with incandescent bulbs, a factor of 20 can
25 be observed, that is, for the same initial amount of micro-organisms in the air, a sterilising system using incandescent bulbs requires 100 watt.hour/cubic meter in order to achieve a negligible amount of micro-organisms in the air.

30 Taking into account these experimental results, it can be concluded that the inventive sterilisation apparatus and method based upon high thermal gradient ducts produced by Joule effect, is highly efficient when compared with existing alternatives. The Joule
35 effect in the inventive apparatus is produced by the passage of an electric current through the resistive

element, such as, a CrNi wire axially layed in ducts and designed according to thermodynamic principles.

A preferred embodiment of apparatus in accordance with the present invention will now be described by way of example and with reference to the accompanying drawings in which:-

Figure 1 shows a circuit diagram used in air sterilisation apparatus; and

Figures 2, 3 and 4 are respective perspective, top and front views of an arrangement of ducts used in the apparatus;

~~Figures 5, 6 and 7 are respective rear, front and bottom views of a housing for the apparatus.~~

Figure 1 shows a circuit diagram comprising a fuse F_1 for protecting the apparatus, a LED as an on-off indicator and a heating element made of NiCr resistive wire whose electrical characteristics are selected in order to suit an air volume to be sterilised.

Figure 2 shows the high thermal gradient ducts which are also designed as a function of the air volume to be sterilised, the material in which the ducts are made being refractory, in order to maximize the heat transfer to the air, which circulates by convection.

Figure 3 shows high thermal gradient ducts of circular form, although any other geometric form can be used alternatively.

Figure 4 shows the front of the above-mentioned arrangement of ducts.

~~Figure 5 shows the rear of an aluminum housing in which the apparatus is located.~~

~~Figures 6 and 7 show the front and rear views of the housing mentioned in the preceding paragraph.~~

The application of the invention here discussed is directly related to the optimization of apparatus suitable for the sterilisation of air.

It can be used in wardrobes, rooms, perishable goods warehouses and in any other place where micro-organisms action must be prevented.

5 This arrangement is also highly efficient against mould and bad smells commonly found in wardrobes, attics, cellars, and the like.

It can also be used in hospitals and clinics where the high level biological activity in the air should be kept to a minimum.



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CLAIMS:

1. An air sterilization apparatus comprising a refractory block having a top and bottom, a plurality of vertically disposed ducts extending through said block from said bottom to said top, said ducts
5 including top and bottom ends and said duct ends communicating directly with ambient air, resistive heating elements disposed within said ducts, and means supplying electrical energy to said heating elements to produce a thermal gradient in said ducts, whereby
10 ambient air is drawn into and upwardly through said ducts solely by convection with minimal increase in temperature of the ambient air due to said air issuing from said ducts.

2. An air sterilization apparatus according to
15 Claim 1 wherein each heating element comprises an axially extending filament within its duct and said filament comprises NiCr wire.

3. A method of air sterilization using a refractory block having a top and bottom, a plurality
20 of vertically disposed ducts extending through said block from said bottom to said top, said ducts including top and bottom ends and said duct ends communicating directly with ambient air, resistive heating elements disposed within said ducts, and means
25 supplying electrical energy to said heating elements to produce a thermal gradient in said ducts wherein ambient air is drawn into and upwardly through said ducts solely by convection with minimal increase in temperature of the ambient air due to said air issuing
30 from said ducts.

4. An air sterilization apparatus substantially as hereinbefore described with reference to the accompanying drawings.



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5. A method of air sterilization substantially as hereinbefore described with reference to the accompanying drawings.
