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IMPROVED STERILISING FILTER ARRANGEMENT,
APPARATUS & METHOD

Field Of Invention

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The present invention relates to an improvement in components used in indoor apparatus which have an internal airflow that is expelled from the apparatus into an indoor human-activity environment.

One aspect of the invention relates particularly to an improvement in a filter arrangement used to sterilise the airflow that emanates from such indoor apparatus.

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Other preferred aspects of the invention relate to features that contribute to the goal of achieving 100% bacteria removal from the airflow.

Other aspects of the present invention also relate to improved devices that give off an airflow, particularly, but not exclusively, to hand dryers, hair dryers, vacuum cleaners, air fans, air conditioners, refrigerators, clothing tumble dryers.

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Background of the Invention

Spread Of Bacteria By Airflow Apparatus

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It is known that indoor apparatus, which draw in air and then expel that air as an airflow into the indoor human-activity environment, are a vehicle for spreading germs, bacteria and viruses. As a result, the people in this environment can more readily come into contact with the bacteria that are spread around by the expelled air from the apparatus.

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For example, the prior art includes a number of hand drying apparatus that emit a stream of warm airflow to dry the hands. It was assumed that the use of such hand drying apparatus is hygienic. Contrary to expectations, however, it has been found that these prior art hand drying apparatus are actually a means of spreading the germs.

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The reason is that the warm airflow from these prior art hand drying apparatus is, itself, laden with airborne bacteria. This is because the hand dryers draw in air from the bacteria-laden atmosphere of the toilet, and expel the warm, germ-infested airflow onto the wet hands of the user.

Moreover, many people do not leave their hands in the warm airstream for long enough to completely dry their hands. As a result, the warm moist environment on the user's hands is ideal for the bacteria, that has been blown onto the hands by the dryer, to multiply rapidly.

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Many of the micro-organisms in the airflow are not killed by the heating element of hand dryers. Moreover, the warm air from a hand dryer is an ideal environment for bacteria to multiply.

- 5 Consequently, these live bacteria are directed onto the user's hands. Indeed, it is found that such hot air blowers in the prior art may actually increase bacteria levels by up to 500%.

The Problem of Less-Than-100% Bacteria Removal

- 10 Even though such prior art hand drying apparatus have found widespread acceptance in public facilities, such as public toilets, there is resistance to using these apparatus in the certain fields, particularly the medical field such as in hospitals and medical clinics, and also in childcare centres and in the food industry.

- 15 For instance, when a surgeon, prior to performing surgery, washes his hands with anti-bacteria liquid or soap, it would be futile if the surgeon's hands were to be re-infected with bacteria, if the surgeon were to dry his wet hands in the warm airflow of a prior art hand drying apparatus.

- 20 Also, in the new Millennium, virologists and public health officials predict a future worldwide pandemic of deadly flu and other viruses in terms of when it will happen, rather than if such a pandemic might occur. When such a global pandemic occurs, it can also be predicted that there will be a need for 100% bacteria removal in indoor apparatus that emit airflows. If not, such apparatus, particularly in public places, even if capable of removing say 90% of bacteria, would still become vehicles for spreading deadly virus in the pandemic. In other words, during a pandemic, 100% bacteria removal would become critically important.

- 25 The prior art contains air-flow apparatus that are intended to kill bacteria and/or remove the bacteria from the airflow of the apparatus, however, in actual practice, such known products do not come close to removing 100% of the bacteria from the airflow in the apparatus, particularly through long-term use.

- 30 Even though such prior art apparatus may kill or remove part of the bacteria in the airflow, the ultimate goal of 100% bacteria removal has remained elusive.

- 35 Hence, at the outset of this specification, a distinction is made between a prior art apparatus that make an assertion of killing or removing bacteria, but, in actual performance, only achieves, say, 80% and even 90 or 95% removal of the bacteria from the airflow, in contrast to the present goal of removing 100% of bacteria from the airflow.

- An invention that aims for 100% bacteria removal faces a different set of obstacles which are unlikely to be addressed by a prior art apparatus that does not necessarily aim for, nor achieve, 100% bacteria removal.

Prior Art

- 40 Attempts have been made in the prior art to enable airflow apparatus to produce a sterilised stream of warm air. A major area of development in this field has focused on the use of ultraviolet (UV)

5 radiation in an attempt to kill the bacteria in the airflow. Contrary to expectations, however, it has been ascertained that UV radiation performs poorly in the task of killing the bacteria in the airstream.

Firstly, it must be remembered that, even if the UV radiation were to kill a large portion of the bacteria, the fact is that the remaining bacteria in the airflow can still reach the user's hands, and begin multiplying in a matter of minutes.

10 Secondly, some microbiologist are of the view that UV radiation does not actually kill the bacteria, but merely sterilizes the bacteria, in that sense that UV merely stops the bacteria from breeding or multiplying. If this is true, then it would mean that the warm airflow, emanating from UV-equipped hand-dryers, would still contain an unhygienic content of live bacteria.

15 This ultimate level of sanitisation, namely 100% bacteria removal, would be particularly important for surgical or medical applications. In this regard, laboratory tests conducted for the inventor show that some ultraviolet-equipped hand drying machines, currently on the market, do not kill 100% of the bacteria in the emitted airflow.

20 Thus, prior art hand drying apparatus are often not favoured for use in medical applications where the strictest standard of sterilisation of hands is critically important, particularly in the area of surgery, and in the medical treatment of open wounds.

25 Another problem is that, over a period of weeks, months or even years, germs can collect inside the apparatus. As airflow is drawn inside the apparatus, through continued use, amounts of bacteria are constantly drawn into the machine. In other words, all the inner surfaces of the machine, which come in contact with the airflow, are constantly exposed to bacteria. Over time, the insides of the machine can become a source of bacteria. When the machine is turned off, or when it is not generating an airflow, the bacteria inside can continue to grow and multiply. When a prior art apparatus is incapable of 100% bacteria removal, then those remanent of the bacteria remains in the apparatus, and then internal surfaces of the apparatus can, over time, become a source of bacteria.

30 Other types of apparatus are also used to spread bacteria indoors by their emitted airflows. For example, air-conditioners draw in air, either from outdoors or from the indoor environment, and then expel the airflow indoors. Thus, if there is not a 100% killing or removal of the bacteria in the airflow expelled from the air conditioner, there is likely to be, over a period of time, a gradual net build-up of bacteria in the air of the indoor environment.

35 As another example, a vacuum cleaner draws in bacteria as it sucks up particulate from the floor or surfaces. While the filtration of the vacuum cleaner system can filter out particulate from the airflow, there remains in the airflow minute particles of bacteria. These are spread into the indoor environment by the airflow emanating from the vacuum cleaner.

40 The same phenomenon of spreading bacteria can be seen in other airflow apparatus that draw in and expel an airflow. These include, for example, hair dryers, fans and clothes dryers. In the case of clothes dryers, bacteria-laden air is drawn in from the indoor environment, and directed onto the clothes.

5 Even a refrigerator draws in air, and expels the bacteria-laden air into the cooling chamber of the refrigerator, exposing foods to the bacteria.

An object of some of the several aspects of the present invention is to provide one or more features that, individually or in combination, enable an apparatus, that emits an airflow into a human activity environment, to achieve 100% bacteria reduction in the airflow leaving the filtration arrangement.

10 Another object of the present invention is to overcome or ameliorate one or more problems in the prior art, or to provide an improved alternative over the prior art.

Discussion of prior art in this specification should not be taken as an admission or a commentary on the state of common general knowledge of the skilled addressee in this field.

15 Summary of Invention

The present specification contains several aspects of the present invention.

20 According to a first aspect of the present invention, there is provided a sterilising hand-drying apparatus adapted to produce a stream of substantially sterilised, heated air for drying hands, the apparatus including:

a housing;

heating-means positioned in the housing for heating of air useable for drying hands;

25 inlet-means through which the air, in use, enters the housing and travels to reach the heating-means;

outlet-means through which the air, in use, after being heated by the heating-means, is emitted as heated air useable for drying hands; and

airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-means via the heating-means to the outlet-means;

30 wherein the apparatus is provided with bacteria-entrapment-filter-means through which, in use, the airflow passes, and

wherein the bacteria-entrapment-filter-means, in use, is adapted to trap and retain therein a substantial portion of bacteria in the airflow, such that the airflow leaving the bacteria-entrapment-filter-means is more sterile than when entering the bacteria-entrapment-filter-means,

35 the entrapment filter-means being in the form of a fibrous matrix that has on its fibres a toxic bacteria-killing substance which is able to kill any bacteria that impinges on the bacteria-killing substance on the fibres.

40 Preferably, the bacteria-killing substance is a liquid-applied substance which, when on the fibre, presents a sticky coating on the fibre which captures bacteria that impinges on the bacteria-killing substance found on the fibres.

5 In the exemplary embodiment, the airflow leaving the bacteria-entrapment-filter-means has numerically fewer bacteria than the airflow entering the bacteria-entrapment-filter-means.

Preferably, the airflow leaving the bacteria-entrapment-filter-means is fully or at least substantially bacteria-free.

10 Preferably, the airflow leaving the bacteria-entrapment-filter-means is 100% free of bacteria particles.

Preferably, the bacteria-entrapment-filter-means intercepts the airflow before the airflow reaches the heating-means.

Preferably, the inlet-means includes at least one main entrance through which all the airflow that is emitted from the hand-drying apparatus has to pass initially through this main entrance

15 Preferably, the at least one main entrances is located totally inside the housing.

Preferably, the at least one main entrance is located in an entrance into the airflow-generation-means such that all air entering the airflow-generation-means passes through this at least one main entrance.

20 Preferably, the airflow-generation-means is contained in a casing and wherein said at least one main entrance is located on the casing.

Alternatively, the at least one main entrance may be located on the housing of the apparatus, provided that all other entrances into the housing, apart from said at least one main entrance, are sealed so that, in operational use, air can only enter the housing through said at least one main entrance.

25 Preferably, the inlet-means includes one or more secondary entrances arranged in series with the main entrance through which the airflow passes sequentially one after another.

The main entrance may be separated from its next nearest entrance in the series by a substantial space that contains sufficient air to satisfy the air intake requirements of the airflow-generation-means in terms of volume of air per unit time.

30 At least one of the secondary entrances may be located on an external surface of the housing, and accessible by the user from outside of the housing.

Preferably, each of said secondary entrances is provided with said bacteria-entrapment-filter-means.

Preferably, the main entrance is provided with said bacteria-entrapment-filter-means.

35 Preferably, said bacteria-entrapment-filter-means includes a fibrous, dense filter material that is sufficiently dense to intercept and entrap a substantial portion of bacteria particles in the airflow.

Preferably, the filter material is a non-woven fibre.

Preferably, the filter material has average gaps or pores between the fibres selected to be around 150 microns.

Preferably, the filter material has an air permeability of around 234.7 cm³/cm²/sec.

40 The bacteria-entrapment-filter-means may include a filter-replacement mechanism that is able to automatically replace the filter material in use with replacement filter material.

5 Preferably, filter-replacement mechanism replaces the filter material in use with replacement filter material periodically after a period of time. Preferably, the filter-replacement mechanism replaces the filter material in use with replacement filter material progressively in a continuous or intermittent manner. Preferably, the filter material is in the form of a sheet-like strip. Preferably, the filter material is conveyed by a motorised reel-mechanism.

10 Preferably, the apparatus is provided with an electric control circuit that supplies electrical power to the apparatus, and wherein the electric control circuit is provided with a cut-off mechanism that disables the supply of electrical power when the housing is opened so as to minimise risk of the user being electrocuted when opening the housing.

15 Preferably, the cut-off mechanism includes a two-state switch which enables the supply of electrical power only when in the first state, and wherein an actuator is provided within the housing that maintains the switch in the first state when the housing is closed, and which activates the switch into the second state when the housing is opened to thereby disable the supply of electrical power to the apparatus when the housing is opened.

20 Preferably, the cut-off mechanism includes a resiliently-mounted switch which enables the supply of electrical power only when depressed, and wherein a cut-off-mechanism-activator is provided within the housing and arranged so as to depresses the switch when the housing is closed, and to lift off the switch when the housing is opened thereby to disable the supply of electrical power to the apparatus when the housing is opened.

25 Preferably, the resiliently-mounted switch is mounted on a base-mounting to which a hood of the housing is removably attachable, and the cut-off-mechanism-activator is mounted on an interior surface of the hood.

Preferably, the cut-off-mechanism-activator is mounted on a base-mounting to which a hood of the housing is removably attachable, and the resiliently-mounted switch is mounted on an interior surface of the hood.

30 The cut-off-mechanism-activator may be in the form of a depressor that activates the cut-off mechanism when in contact therewith.

The base-mounting may be adapted to be fastened to an upright mounting surface, such that the hand-drying apparatus is able to be installed onto the upright mounting surface by attaching the housing to the base-mounting.

35 The hand-drying apparatus may be provided with a timer-control-circuit to regularly auto-activate the airflow-generation-means for a predetermined period of time so that the hand-drying apparatus effectively sterilises part of the ambient atmosphere surrounding the hand-drying apparatus.

The timer-control-circuit may auto-activate the apparatus without concurrently activating the heating-means.

40 Alternatively, the timer-control-circuit may auto-activate the apparatus while concurrently activating the heating-means.

5 The timer-control-circuit may be provided with light-sensor-means and only auto-activates the apparatus only the light-sensor indicates that there is ambient light.

 Preferably, the apparatus is provided with hand-sensor-means which detects the presence of hands in the vicinity of the outlet-means and is adapted to activate the airflow-generation-means and the heating-means when hands are so detected, and wherein the timer-control-circuit only auto-activates the
10 apparatus when the hand-sensor-means detects that there is no presence of hands in the vicinity of the outlet-means.

 Preferably, the bacteria-entrapment-filter-means includes an airborne-bacteria filter arrangement described below.

15 According to a second aspect of the present invention, there is provided a method of producing a stream of substantially sterilised, heated air from a sterilising hand-drying apparatus for drying hands, the method including:

 using airflow-generation-means to move air swiftly as an airflow;

 heating the air with heating-means so that the airflow is useable for drying hands;

20 providing the hand-drying apparatus with bacteria-entrapment-filter-means through which, in use, the airflow passes; and

 wherein the bacteria-entrapment-filter-means, in use, is adapted to trap and retain therein a substantial portion of bacteria in the airflow, such that the airflow leaving the bacteria-entrapment-filter-means is more sterile than when entering the bacteria-entrapment-filter-means,

25 the entrapment filter-means being in the form of a fibrous matrix that has on its fibres a toxic bacteria-killing substance which is able to kill any bacteria that impinges on the bacteria-killing substance on the fibres.

 According to a third aspect of the present invention, there is provided a sterilising hand-drying
30 apparatus adapted to produce a stream of substantially sterilised, heated air for drying hands, the apparatus including:

 a housing;

 heating-means positioned in the housing for heating of air useable for drying hands;

35 inlet-means through which the air, in use, enters the housing and travels to reach the heating-means;

 outlet-means through which the air, in use, after being heated by the heating-means, is emitted as heated air useable for drying hands; and

 airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-means via the heating-means to the outlet-means;

40 wherein the apparatus is provided with an electric control circuit that supplies electrical power to the apparatus,

5 and wherein the electric control circuit is provided with a cut-off mechanism that disables the supply of electrical power when the housing is opened so as to minimise risk of the user being electrocuted when opening the housing.

10 Preferably, the cut-off mechanism includes a two-state switch which enables the supply of electrical power only when in the first state, and wherein an actuator is provided within the housing that maintains the switch in the first state when the housing is closed, and which activates the switch into the second state when the housing is opened to thereby disable the supply of electrical power to the apparatus when the housing is opened.

15 Preferably, the cut-off mechanism includes a resiliently-mounted switch which enables the supply of electrical power only when activated, and wherein a cut-off-mechanism-activator is provided within the housing and arranged so as to activate the switch when the housing is closed, and to deactivate the switch when the housing is opened thereby to disable the supply of electrical power to the apparatus when the housing is opened.

20 The resiliently-mounted switch may be mounted on a base-mounting to which a hood of the housing is removably attachable, and the cut-off-mechanism-activator is mounted on an interior surface of the hood.

The cut-off-mechanism-activator may be mounted on a base-mounting to which a hood of the housing is removably attachable, and the resiliently-mounted switch is mounted on an interior surface of the hood.

25 The cut-off-mechanism-activator may be in the form of a depressor that activates the cut-off mechanism when in contact therewith.

The base-mounting may be adapted to be fastened to an upright mounting surface, such that the hand-drying apparatus is able to be installed onto the upright mounting surface by attaching the housing to the base-mounting.

30 According to a fourth aspect of the present invention, there is provided baseplate to which a hood of a housing of a sterilising hand-drying apparatus is adapted to be removably attached,

wherein the hand-drying apparatus is provided with an electric control circuit that supplies electrical power to the apparatus,

35 and wherein the baseplate is provided with a cut-off mechanism that disables the supply of electrical power to the electric control circuit when, in use with the hood attached to the baseplate, the housing is opened so as to minimise risk of the user being electrocuted when opening the housing.

40 According to a fifth aspect of the present invention, there is provided a sterilising hand-drying apparatus adapted to produce a stream of substantially sterilised, heated air for drying hands, the apparatus including:

5 a housing;
heating-means positioned in the housing for heating of air useable for drying hands;
inlet-means through which the air, in use, enters the housing and travels to reach the heating-
means;
outlet-means through which the air, in use, after being heated by the heating-means, is emitted
10 as heated air useable for drying hands; and
airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-means via
the heating-means to the outlet-means;
wherein the hand-drying apparatus is provided with a timer-control-circuit to regularly auto-
activate the airflow-generation-means for a predetermined period of time.

15 The timer-control-circuit may auto-activate the apparatus without concurrently activating the
heating-means.

Alternatively, the timer-control-circuit may auto-activate the apparatus while concurrently
activating the heating-means.

20 The timer-control-circuit may be provided with light-sensor-means and only auto-activates the
apparatus only the light-sensor indicates that there is ambient light.

The apparatus may be provided with hand-sensor-means which detects the presence of hands in
the vicinity of the outlet-means and is adapted to activate the airflow-generation-means and the heating-
means when hands are so detected, and wherein the timer-control-circuit only auto-activates the apparatus
25 when the hand-sensor-means detects that there is no presence of hands in the vicinity of the outlet-means.

The apparatus may be provided with a fragrance-material that is a source of fragrance so that the
fragrance infuses into the airflow.

According to a sixth aspect of the present invention, there is provided a timing circuit component
30 adapted to regularly auto-activate airflow-generation-means in a sterilising hand-drying apparatus for a
predetermined period of time,

the sterilising hand-drying apparatus adapted to produce a stream of substantially sterilised,
heated air for drying hands, the apparatus including:

a housing;
35 heating-means positioned in the housing for heating of air useable for drying hands;
inlet-means through which the air, in use, enters the housing and travels to reach the heating-
means;
outlet-means through which the air, in use, after being heated by the heating-means, is emitted
as heated air useable for drying hands; and
40 said airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-
means via the heating-means to the outlet-means;

5 wherein the timer-control-circuit is adapted to regularly auto-activate the airflow-generation-means for a predetermined period of time.

 According to a seventh aspect of the present invention, there is provided a method of sterilising ambient atmosphere around a sterilising hand-drying apparatus that is adapted to produce a stream of
10 substantially sterilised, heated air for drying hands, the method including:

 providing the hand-drying apparatus with a timer-control-circuit that is adapted to regularly auto-activate the airflow-generation-means for a predetermined period of time; and

 using the timer-control-circuit to auto-activate the sterilising hand-drying apparatus periodically for a predetermined period of time,

15 wherein the hand-drying apparatus includes:

 a housing;

 heating-means positioned in the housing for heating of air useable for drying hands;

 inlet-means through which the air, in use, enters the housing and travels to reach the heating-means;

20 outlet-means through which the air, in use, after being heated by the heating-means, is emitted as heated air useable for drying hands; and

 airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-means via the heating-means to the outlet-means.

25 According to a eighth aspect of the present invention, there is provided a method of fragrancing ambient atmosphere around a hand-drying apparatus that is adapted to produce an airflow of heated air for drying hands, the method including:

 providing the hand-drying apparatus with a timer-control-circuit that is adapted to regularly auto-activate the airflow-generation-means for a predetermined period of time;

30 providing the apparatus with a fragrance-material that is a source of fragrance so that the fragrance infuses into the airflow; and

 using the timer-control-circuit to auto-activate the hand-drying apparatus periodically for a predetermined period of time, which effectively causes the fragrance in the airflow to fragrance the ambient atmosphere around the hand-drying apparatus;

35 wherein the hand-drying apparatus includes:

 a housing;

 heating-means positioned in the housing for heating of air useable for drying hands;

 inlet-means through which the air, in use, enters the housing and travels to reach the heating-means;

40 outlet-means through which the air, in use, after being heated by the heating-means, is emitted as heated air useable for drying hands; and

5 airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-means via the heating-means to the outlet-means.

 According to a ninth aspect of the present invention, there is provided a sterilising hand-drying apparatus adapted to produce a stream of substantially sterilised, heated air for drying hands, the
10 apparatus including:

 a housing;

 heating-means positioned in the housing for heating of air useable for drying hands;

 inlet-means through which the air, in use, enters the housing and travels to reach the heating-means;

15 outlet-means through which the air, in use, after being heated by the heating-means, is emitted as heated air useable for drying hands;

 airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-means via the heating-means to the outlet-means; and

 filter material adapted to filter the airflow;

20 wherein the apparatus includes a filter-replacement mechanism that is able to automatically replace the filter material in use with replacement filter material.

 According to a tenth aspect of the present invention, there is provided a sterilising hand-drying apparatus adapted to produce a stream of substantially sterilised, heated air for drying hands, the
25 apparatus including:

 a housing;

 heating-means positioned in the housing for heating of air useable for drying hands;

 inlet-means through which the air, in use, enters the housing and travels to reach the heating-means;

30 outlet-means through which the air, in use, after being heated by the heating-means, is emitted as heated air useable for drying hands; and

 airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-means via the heating-means to the outlet-means;

35 wherein the inlet-means includes at least one main entrance through which all airflow in the apparatus must pass through said at least one main entrance, and

 wherein the at least one main entrance is located in an entrance into the airflow-generation-means such that all air entering the airflow-generation-means passes through this at least one main entrance which is filtered.

40 According to a eleventh aspect of the present invention, there is provided an airborne-bacteria filter arrangement adapted to be used with an apparatus that draws in and expels an airflow into a human-

5 activity environment, the filter arrangement including the following through which the airflow passes in sequence:

i) entrapment filter-means in the form of a fibrous matrix that has on its fibres a toxic bacteria-killing substance which is able to kill any bacteria that impinges on the bacteria-killing substance on the fibres.

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Preferably, after the entrapment filter-means, the airflow passes through:

ii) carbon filter-means that intercepts and removes from the airflow any of the toxic bacteria-killing substance that originates from the entrapment filter means so that the airflow leaving the filter arrangement into the human-activity area is substantially free both of bacteria and of traces of the bacteria-killing substance.

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Preferably, the airborne-bacteria filter arrangement is located fully inside the apparatus interior.

Preferably, the filter arrangement is provided with filter-barrier-means which, in use, houses the entrapment filter means and the charcoal-filter-means so as to provide a bacteria-impermeable barrier therefor.

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Preferably, the bacteria-impermeable barrier of the filter-barrier-means separates the entrapment filter means and the charcoal-filter-means from the interior of the apparatus such that, in use with the airflow, bacteria or other contaminants inside the apparatus can only enter the filter arrangement via the entrapment filter means and not through other parts of the filter arrangement.

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Preferably, the bacteria-impermeable barrier includes components that are adapted to fit together such that, when fitted together, bacteria cannot enter the interior of the filter arrangement through points of abutment of the components.

Preferably, the bacteria-impermeable barrier of the filter-barrier-means also prevents any live bacteria inside the filter arrangement from escaping therefrom back into the apparatus interior.

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Preferably, the entrapment filter means and the charcoal-filter-means are separated by a volumetric region that is sealed within the bacteria-impermeable barrier such that the volumetric region acts as an interim destination for the airflow to enter after leaving the entrapment filter means.

Preferably, the entrapment filter means and the charcoal-filter-means are generally parallel to one another such that the volumetric region therebetween is a flat and planar-like.

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Preferably, in use, the airflow leaves the entrapment filter means and enters the charcoal-filter-means in a manner that the airflow is substantially perpendicular to the surfaces of each of the filter-means.

Preferably, the entrapment filter means and the charcoal-filter-means are followed next, in sequence, by an emitting-filter-means containing a beneficial emittable-substance which, in use, is infused into the airflow expelled from the filtration arrangement.

5 The entrapment filter means and the charcoal-filter-means may be followed next, in sequence, by two or more emitting-filter-means each containing a different beneficial emittable-substance which, in use, is infused into the airflow expelled from the filtration arrangement.

 The beneficial emittable-substance may include a pharmaceutical that is able to be administered to a user in an airborne manner.

10 The beneficial emittable-substance may include a fragrance.

 The beneficial emittable-substance may include an anti-bacterial substance.

 Preferably, the beneficial emittable-substance is combined with an air-flow activated composition described below, wherein the beneficial emittable-substance is the active substance.

15 At least the emitting-filter-means may be in the form of a flat piece of filter material that is supported in the filter arrangement such that the flat piece is able to flutter in the airflow.

 Preferably, the bacteria-killing substance is a liquid-applied substance which, when on the fibre, presents a sticky coating on the fibre which captures bacteria that impinges on the bacteria-killing substance found on the fibres.

20 Preferably, the sticky coating is able to physically hold impinging bacteria particles to the fibre so that the bacteria are held and killed in that location.

 Preferably, the charcoal filter-means is a fibrous matrix infused with charcoal particles.

 Preferably, the charcoal-filter-means re-oxygenates the airflow and removes odours.

25 Preferably, each of the filters is housed in a filter-holder, and where each of the filter-holders is provided with attachment-sequence-means that ensure that the filters can only be attached one to the other in the aforesaid sequence.

 Preferably, when each of the filters holders is attached to one of the other in the aforesaid sequence, the filter-holders combine to provide said bacteria-impermeable barrier.

30 Preferably, the attachment-sequence-means on each filter-housing is in the form of a shaped contour that can only mate precisely with a corresponding contour on the filter-housing that is next in the aforesaid sequence.

 Preferably, the filter-holders fit together in the aforesaid sequence to form a stack.

 Preferably, the fibrous matrix is adapted to physically capture bacteria particles and, at the same time, also to present minimal impedance to the airflow, and, as such, the fibrous matrix is therefore characterised by:

35 average gaps or pores between the fibres that are very significantly larger than the size of bacteria so as to present minimal impedance to the airflow; and

 a tortuous path for the airflow created by the fibrous matrix so that the bacteria particles have an extremely high probability of impacting at least some of the fibres of the matrix.

 Preferably, the average gaps or pores between the fibres is selected to be around 150 microns.

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- 5 According to a twelfth aspect of the present invention, there is provided an air-flow activated composition including:
- an active substance capable of becoming airborne at least for a useful period of time; and
- a release agent to restrain the active substance from becoming airborne at normal room
- temperature and pressure,
- 10 wherein upon exposure of the composition to flowing air, the release agent will release the active ingredient into the air stream.

 Preferably, the active substance is a biocide and/or a fragrance.

 Preferably, the release agent is a microporous polymer.

- 15 The release agent may be a microcapsule polymer shell.

 The release agent may be a melamine-formaldehyde microencapsulate shell.

 The shells may range in size between 5-100µm micrometers.

 Preferably, the composition is sprayed on to the substrate in a liquid emulsion.

- There is provided a filter, installed in an air blowing device whereby air passed over or through
- 20 the filter whereby to release the active substance.

- Other preferred or optional features of this twelfth aspect of the invention are summarised and described towards the end of the specification, rather than at this point in the specification, merely for the sake of clarity, so that in the specification, the chemical aspects of the invention may be, as far as
- 25 possible, separated from the mechanical aspects.

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Drawings

10 In order that aspects of the present invention might be more fully understood, embodiments of each aspect of the present invention will be described, by way of example only, with reference to the accompany drawings, in which:

Figure 1A is a bottom perspective view of an embodiment of a sterilising hand-drying apparatus, shown with its secondary filter arrangement depicted in exploded view – the embodiment is shown as it would be viewed from below when mounted on an upright surface, such as a wall;

15 Figure 1B is an upper perspective view of the same embodiment of Figure 1A, except with the apparatus shown opened up to reveal its internal components inside the housing, and the main filter arrangement positioned on the fan-casing;

Figure 1C shows a front view of a baseplate for the embodiment of Figures 1A and 1B, and shows the baseplate as it would appear, face on, when mounted on an upright surface, such as a wall;

20 Figures 2A and 2B show side views of the embodiment of Figure 1A, with Figure 2A showing the apparatus with the housing in a closed arrangement, and Figure 2B showing the same apparatus with the housing in an opened arrangement. (Certain internal components are shown in Figures 2A and 2B using dotted lines. Details of most of the internal components inside the hood, however, have been omitted from Figures 2A and 2B for the sake of clarity);

25 Figure 3 shows an exploded view of a first embodiment of a filter arrangement of the main filter that is used in the main aperture in the embodiment of Figure 1A;

Figure 4 is a bottom perspective view of the fan-casing that is seen in Figure 1B, except that here the fan-casing is shown separately to reveal its underside and the heating elements. Also shown in Figure 4 is an exploded perspective view of components of the embodiment of the main filter arrangement shown relative to where these fit into the main aperture of the fan-housing;

30 Figure 5 is a simplified block diagram of electrical circuitry elements of an embodiment of the hand drying apparatus;

Figure 6A illustrates a see-through perspective view of a further modified embodiment which has a filter-replacement mechanism that continuously or intermittently feeds a sheet-like filter material across an aperture in the housing;

Figure 6B is a modification of the embodiment of Figure 6A;

Figure 7A shows an exploded side view of a second embodiment of a main filter arrangement that can be used to fit into the main aperture of Figure 4;

Figure 7B shows an assembled side view of the filter arrangement of Figure 7A;

40 Figure 8A show an exploded view of a third embodiment of a main filter arrangement, having three filter components, compared to the two components of the embodiment of Figures 7A and 7B;

5 Figure 8B shows an assembled side view of the filter arrangement of Figure 8A;
 Figure 8C shows a fourth embodiment of a main filter arrangement having four filter
components;

 Figure 8D shows an assembled side view of the filter arrangement of Figure 8C having four
filter components;

10 Figures 9A and 9B show an embodiment where filters pieces are installed inside their filter
 housings, with Figure 9A shown when there is no airflow, and Figure 9B shown when an airflow passes
 through;

 Figure 10A shows yet a further embodiment of a filter arrangement used with a hair drying
 apparatus;

15 Figure 10B shows a modification of the embodiment of Figure 10A, with the modification being
 that the filter arrangement has an additional substance-effusing filter;

 Figure 10C shows another modification of the embodiment of Figure 10A, having a four-filter
 arrangement similar to that shown in Figure 8C;

 Figure 11A shows yet another embodiment of a filter arrangement used with a vacuum cleaner;

20 Figure 11B shows another modification of the embodiment of Figure 11A, having a four-filter
 arrangement similar to that shown in Figure 8C;

 Figures 12A, 12B and 12C show a different embodiment of a filter arrangement, in front, side
 and exploded side views respectively, used with an air-circulation fan;

25 Figures 12D and 12E show a further embodiment of a filter arrangement used with a fan, having
 a four-filter arrangement that has a similar function to that of the embodiment in Figure 8C;

 Figure 13 is a simple schematic diagram of an embodiment of a filter arrangement incorporated
 in a clothes dryer; and

 Figure 14 is a simple schematic diagram of an embodiment of a filter arrangement incorporated
 in a refrigerator.

30 It is noted that Figures 6A and 6B have been drawn with minimum detail, only showing details
 of embodiments of a filter-replacement mechanism. For the sake of simplicity, other internal details of the
 dryer have been omitted from Figures 6A and 6B, and likewise for Figures 13 and 14.

35 In the drawings of different embodiments, like elements have been shown with like reference
 numerals, merely for ease of understanding the various embodiments.

 The embodiments are intended to kill a full spectrum of bacteria, germs and the like, and the
 terms bacteria or germs are used in a general sense, and should not be construed narrowly from any
 biological definitions that would otherwise limit the invention to killing a certain type of harmful micro-
 organism.

40

5

Description of Embodiments

Referring to the accompanying drawings, Figure 1A shows a sterilising hand-drying apparatus in the form of a hand dryer 1.

10 The dryer 1 draws in and expels an airflow into a human-activity environment frequented by people, such as a toilet, or in a washroom such as in a hospital, to name but a few examples.

The hand dryer 1 is adapted to emit or expel an airflow or stream of substantially sterilised, heated air 200C for drying hands. In the exemplary embodiment, the operational range of the heated air is around 55 to 65 degrees Centigrade.

15 The hand dryer 1 has a housing which includes a main hood 10 and a base-mounting in the form of a baseplate 11. The baseplate 11 is best seen in Figures 1B and 1C, and also in Figures 2A and 2B.

In Figure 1B, the hood 10 is mounted to the baseplate 11 by hinges 12.

20 The hinges 12 are designed such that the hood 10 can be detached or removed from the baseplate 11. This enables the hand dryer 1 to be installed in the simple two-step process: firstly, the baseplate 11 is mounted to an upright surface such as a wall, and secondly, the hood 10 is attached to the hinges of the baseplate 11.

The baseplate 11 is secured to the wall with screws 13, bolts or other appropriate fastening mechanism.

Figure 1A shows the hood 10 arranged in a closed position, which is the arrangement when the dryer 1 is in installed in location.

25 Figure 1B shows the hood 10 arranged in an opened position.

In both Figures 1A and 1B, the orientation of the dryer 1 has been drawn as it would be when mounted on a wall.

In a commercial embodiment, the hood 10 is locked to the base-plate 11, and requires a special key 16A to unlocked the lock 16B, as seen in Figures 1A and 1B.

30

Air-Flow

35 As an overall summary, when the dryer 1, in use, is operated to dry a user's hands, air from the ambient environment is drawn or sucked into the housing, and then heated, and expelled, in that sequence. The path of this airflow is notionally depicted by arrow 200A in Figure 1A, then arrow 200B in Figure 1B, and finally arrow 200C in Figure 1A. Of course, the actual flow of the air in the dryer 1 is much more complex and turbulent, and so the arrows 200A, 200B, 200C are a simplification for the sake of illustration.

5 Air Heater

In Figure 4, the dryer 1 is provided with heating-means in the form of a heating element 300. The heating element 300 is located at an opening of the fan-casing 400, and is shown more clearly in the separate bottom perspective view of the fan-casing 400 in Figure 4.

10 The heating element 300 includes a grid of wires or plates adapted to be heated up electrically when the dryer 1 is emitting the hot airflow.

Regarding Figures 1B and 4, the heating element 300 is positioned inside in the housing 10, 11, and is used to heat up the airstream 200B so that the air is sufficiently warm to dry the user's hands.

15 Inlet-Means

The dryer 1 has an inlet-means through which the air, in use, enters the housing 10, 11 and travels to reach the heating element 300.

In the embodiment, the inlet-means is regarded as a region or passage through which the air
20 travels to reach the heating element 300.

In Figure 1B, the inlet-means encompasses quite a range of components and features in the embodiment of Figure 1B. To begin with, the inlet-means includes a secondary filter assembly 520A, 520B, 520C through which air enters the housing.

The inlet-means also include the cavernous interior of the housing 10, 11. The air flows through
25 the secondary filter assembly 520A, 520B, 520C and then into the interior of the cavernous interior of the housing 10, 11.

The inlet means also includes a main-entrance 405 located in the side of the fan-casing 400. Into this main-entrance 405 is inserted a main airborne-bacteria filter arrangement in the form of main-filter assembly 410A, 410B, 410C (and other embodiments described below).

30 An exploded view of a first embodiment of the main filter assembly 410A, 410B, 410C is shown in Figure 3.

Figure 4 shows the embodiment of the main filter assembly, in relation to where it fits into the main entrance 405 of the fan-casing 400.

In Figure 4, the main filter assembly preferably includes a base element 410A that fits directly
35 into the main entrance or main aperture 405. In Figure 7B, the base element 410A is provided with several resilient claws 408 that enable the base element to engage and lock with the main aperture 405.

Figure 3 shows an exploded view of parts of the main filter assembly 410A, 410B, 410C.

In Figures 3 and 4, a bacteria entrapment filter-means in the form of a filter material 410B is attached to the filter holder 410C. The filter holder 410C is able to engage with the base element 410.

5 The filter material 410B is provided with slits which are used to mount the filter on the filter holder 410C. In use, protruding pins 411 on the filter holder 410C, pass through the slits in the filter, as seen in Figure 4 and best in Figure 7B.

Each of the filter holders 410A, 410C has a coarse mesh 414 that is also limits the movement of the filter material 410B in place.

10 The base element 410A and the filter holder 410C are provided with corresponding bayonet mounting parts, that enable these parts to fit together with a bayonet-style engagement. In other embodiments, other forms or styles of engagements mechanisms can be used, such as inter-fitting pins or press fit mounting, or press-and-lock mountings.

15 Outlet-Means

The dryer 1 has an outlet-means through which the air, after being heated by the heating element 300, is emitted as a heated airflow 200C that is used for drying hands.

20 In the embodiment, the outlet-means is regarded as region or passage through which the air travels away from the heating element 300 until it is expelled from the dryer 1.

In Figure 1A, the heating element 300 is located inside a projecting snout-like opening 14 on the front of the hood 10. Hence, in the exemplary embodiment, the outlet-means is rather short in overall distance, compared to the distance the air has to travel through the inlet-means.

25 The heated air, that flows past the heating elements 300, exits the housing almost immediately through the opening 14.

The opening 14 has a grille 15 which prevents the user's fingers from touching the heated parts of the heating element 300.

Fan

30 The airflow 200A, 200B, 200C through the dryer 1 is created by airflow-generation-means in the form of a rotating fan 401, seen in Figure 4. The fan 401 is in the form of a rotor that revolves inside the fan-casing 400. Inner portions of the circular fan 401 can be seen in Figure 4. The generally circular shape of the fan-casing 400 accommodates the circular fan 401. The rotation of the fan 401 is operated by
35 a motor 430, seen in Figure 1B. In the example, the motor is a 125 watt, 7500 rpm universal motor. The casing of the motor 430 is sealed to avoid bacteria entering the airflow in the fan-casing 400 via any gaps in the casing of the motor 430.

40 The rotating fan 401, located in the fan-casing 400, is adapted to move the air swiftly as an airflow. The airflow enters into the housing via the initial secondary aperture 520D and its secondary filter assembly 520A, 520B, 520C, then through the cavernous interior of the housing 10, 11, and then through the main aperture 405 and through the main-filter assembly 410A, 410B, 410C until the airflow

5 reaches the heating elements 300. Then, the airflow or air current, generated by the fan 401, is expelled from the housing as a heated airflow 200C that is able to be used for drying the user's hands.

Location of the Main Filter Arrangement

10 The inlet-means of the dryer 1 includes at least one "main entrance" in the form of a main aperture 405. This main aperture is intended as the only entrance for air and bacteria to enter the fan-casing 400.

The notion of a "main entrance" is that all the airflow that is emitted from the dryer has to finally pass initially through this main entrance. In the embodiments, an opening would be defined to be a
15 "main aperture" or "main entrance" if literally all the air in the airflow that comes out of the dryer, at some point, has to pass through that aperture or entrance.

By placing an effective bacteria-entrapping filter on the one or more main entrances, it ensures that all airflow coming out of the dryer is intercepted by a bacteria-entrapping filter.

In the embodiment, the main aperture 405 is located on the fan-casing 400. The main aperture
20 405 is in an opening in the fan-casing 400, such that all air that enters the fan-casing 400 has to pass through this final filter 410B. After the airflow enters the fan-casing, there is only one exit 14 out of the apparatus 1. Therefore, this aperture 405 is regarded as a "main entrance" because, apart from this, there is no other entrance into the fan-casing. In other words, there is no other path that leads to the final exit 14.

25 As an aside, to make the definition of an "main entrance" more understandable, for example, the secondary entrance 520D, in Figure 1A, cannot be regarded as a "main entrance" because there could be numerous other ways for air to enter the apparatus. For instance, bacteria could bypass the secondary filter 520D when the hood 10 is opened, or even enter through gaps in the hood 10 and baseplate 11 when the hood 10 is closed. For example, when the hood 10 is opened, bacteria-laden ambient air of the toilet
30 floods into the interior of the apparatus 1. Also, in between the entrance 520D and the final exit 14, there are numerous internal surfaces inside the apparatus 1 which, over months or years of use, can become infested and act as sources of bacteria. The secondary filter 520B would not intercept this extraneous bacteria that enters the airflow through other ways, such as the opened hood or from internal surfaces, but the final main filter 410B would stop such extraneous bacteria. That is why the secondary entrance 520D
35 is not regarded as a "main entrance", and why the secondary filter 520B is not regarded as a "main filter".

The main entrance, in the form of main aperture 405, can be seen in Figure 4. In the illustration in Figure 1B, this main aperture 405 is obscured because the main filter assembly 410A, 410B, 410C is shown inserted into this main aperture 405 in the fan-casing.

This main filter-assembly 410A, 410B, 410C intercepts the airflow before the airflow reaches
40 the heating element 300. The main aperture 405 is the point in the airflow where all the airflow in the dryer must pass through if it is to be expelled from the dryer. Here, bacteria particles are finally entrapped

5 and thus stopped from entering the fan-casing 400. Preferably, the rest of the casing 400, 430 is sealed such that air cannot enter, for instance, through the motor casing 430.

By placing the main filter arrangement 410A, 410B, 410C at the final point of entry into the fan-casing, it acts as the last possible line of defence. It ensures that all the bacteria, that might have remained in the airflow, is intercepted by the main filter 410B. Even if bacteria enters the machine
10 unexpectedly through gaps in the walls of the apparatus, or from long-term bacteria accumulation inside the apparatus, such bacteria cannot be expelled through the emanating airflow 200C from grille 15, because any airflow leaving the apparatus must finally pass through the main filter arrangement 410A, 410B, 410C.

Thus, the identification of the main entrance, and the location of the main filter arrangement at
15 that final entry point 405 to the fan-housing, is a feature that contributes to the ability of the apparatus 1 to achieve 100% removal and destruction of bacteria in the airflow 200C that emanates from the drying apparatus 1.

It is believed that, in the prior art, achievement of 100% bacteria removal would be difficult, if no consideration is given to addressing the fact that the internal surfaces inside the apparatus are also a
20 potential source of bacteria. Every internal surface and part inside the apparatus is a potential source of contaminants. For example, internal-painted surfaces can give off toxins, and also the airflow can cause debris to come off internal parts after years of use. In the prior art, a filter that is positioned very early in the airflow path would not guard against bacteria coming off internal surfaces that are downstream of the filter.

Hence, in the embodiment, it is preferred that the final main filter 410B is located directly on
25 the fan-housing, so that all of these extraneous contaminants and bacteria, upstream in the airflow, can be caught and intercepted by the final and main filter arrangement 410A, 410B, 410C before it enters the fan-housing. The main filter arrangement is located at the last possible location before the airflow reaches the heating element 300 and the exit point 15. (It would be inconvenient to place the filter inside the fan-
30 housing, because this could not easily be replaced, and a filter that is not easily replaced can, over time, itself become a source of contamination).

In the embodiment, the main aperture 405, and the associated main filter assembly 410A, 410B, 410C, are located totally inside the apparatus housing 10, 11. This ensures that users cannot access the main filter assembly, and that it can only be accessed and replaced by authorised personnel.

35 In other modifications, there may be more than one or more main apertures 405 located on the fan-casing 400, but in such modified embodiments, it is still required that all air entering the fan-casing 400 has to pass through these one or more main-apertures 405 on the fan-casing.

In the present embodiment, even if bacteria were to enter through gaps in the housing 10, 11, the location of the main filter 410B on the fan-casing, being the only entrance leading into the fan-casing,
40 ensures that this main filter 410B can intercept all bacteria that enters the fan-casing 400.

5 In the embodiment of Figure 1A and 1B, the main entrance 405 is located in an entrance leading into the airflow-generation-means, or in other modifications its actual location can be modified, provided that all air entering the airflow-generation-means passes through this final entrance.

10 In the embodiments, the main aperture (or main apertures) is only located on or connected to the fan-casing 400, such that all airflow entering the fan-casing has to pass through this main aperture. This is the preferred and best location, as shown in the embodiment of Figure 1 A.

Another factor in designing the embodiment is that the main aperture, which is the main and only opening into the fan-casing 400, should preferably not be accessible from the outside of the dryer 1. For instance, the main aperture 405 into the fan casing 400 cannot be accessible from the outer surface of the hood 10, otherwise it would enable unauthorised users to have access into the moving parts and the electrically-wired parts of the hand dryer apparatus 1. It would also offer vandals an opportunity to insert harmful matter into the motorised parts of the apparatus, and even squirt water into the fan and motor. All these possibilities would pose a danger to users of the dryer 1.

Bacteria-Entrapment

20 Bacteria is actually comprised of extremely minute, microscopic particles. The dryer 1 of the present embodiment is provided with bacteria-entrapment-filter-means. In other words, a means for trapping the bacteria particles so that the air which is emitted from the dryer 1 is actually free from or devoid of the bacteria particles. The focus is not just on killing the bacteria, but also on entrapping the bacteria particles.

25 In the present embodiment, in Figure 3, the bacteria-entrapment-filter-means of the main-filter assembly 410A, 410B, 410C includes the filter material 410B which is a fibrous, dense, generally non-uniform matrix of filter material that is sufficiently dense to intercept and entrap a substantial portion of the bacteria particles in the airflow. The fibres act as a physical obstacle to the passage of the bacteria particles.

30 In the embodiment, it is found that the filter material 410B ideally needs to be replaced around once per month, given its regular use, for instance, in a typical public toilet facility, since there would be a build-up of bacteria particles in the filter material.

Filter Material

In the exemplary preferred embodiment, the filter material is a melded, non-woven fibrous material. Non-woven fibres are preferred because it is found that woven materials are less suitable, with their tighter weave, which tend to restrict airflow more than non-woven fibrous materials.

40 The filter material in the embodiment of Figure 1A is a non-woven, needle-felt, polyester fibrous pad of material, which has the following characteristics:

5

Weight (gsm)	150	ISO 9073-1: 1989
Thickness (mm)	1.4 mm to 1.8 mm	ISO 9073-2: 1995
Tensile Strength (N/50mm):	165	ISO 9073-3: 1989
- Machine Direction	165	
- Cross Machine Direction		
Air Permeability (l/sec/m ²)	2,500	ISO 9230 @ 20 cm ² /200Pa

In another preferred sample of filter material, a determination of air permeability was conducted according to Australian Standard AS 2001.2.34-90. The results were that the preferred sample of filter material had an air permeability of 234.7 cm³/cm²/sec, with a coefficient of variation of 5.9.

10 The filter material is a melded polyester fibrous matrix that has a totally random weaving matrix, or random lay. Thus, the bacteria particles in an airstream, that pass through this fibrous matrix, have to pass through a tortuous flow-path to navigate through the random, fibrous matrix, thus increasing the likelihood of each bacteria particle impacting and being entrapped by or on one of the fibres.

15 It is often a compromise between choosing between the conflicting requirements of a dense filter to assist in bacteria capture, versus a less dense filter to ensure faster airflow.

The problem is this: an increase in the denseness or thickness of the filter would, on one hand, more effectively capture the bacteria particles, but, at the same time, would also slow down the airflow through the filter, which can cause the fan-motor to overheat. Therefore, some experimentation may be required to find the appropriate denseness of filter material used with the particular powered motor and fan for a given embodiment, if it is desired to achieve the preferred object of 100% bacteria-interception. For instance, with a more powerful fan that produces a stronger airflow, a denser and/or thicker filter material may be used.

The filter mesh weight in gsm (grams per metre square) gives an indication of the nature of the average size of gaps in the filter mesh.

25 For example, it was found that a fibrous matrix of a 50 gsm material adequately entrapped bacteria particles, but the 50 gsm fibrous material was found not to provide sufficient airflow to the fan 401.

30 In the prior art, there is tendency to attempt to achieve bacteria-filtration by selecting extremely fine filter meshes. The notion in the prior art is similar to that of a net for catching fish, where the mesh size has to be sufficiently small to match the size of the bacteria. That creates a problem because, as mesh size decreases, so does the ability of the airflow the pass through at high speeds. This problem is not

5 readily acknowledged in known prior art that refers to very fine sterilising filters, without realising the problems that can be associated with extremely fine filter mesh sizes.

The present embodiment recognises the issue of conflicting needs. On one hand, it is desirable for the filter mesh to be sufficient to catch the bacteria particles, but, on the other hand, the mesh cannot be so small that it impedes optimum airflow.

10 In the present embodiment, the mesh size is selected as being around a 150 micron weave, in the sense that the non-woven material has average gaps or pores between the fibres of around 150 microns. This has been selected from the vast range of filter materials as being in the size-region where very fast airflow is achievable, while retaining the capacity to entrap 100% of the bacteria. The ability to use a relatively large pore-sized 150 micron weave is made possible because the filter is used in conjunction
15 with a sticky liquid coating on the filter, described below.

Without being limited by theory, it is postulated that a 150 micron weave might not have been recognised, in the prior art, as a suitable mesh size for bacteria entrapment because the pores of a 150 micron weave are very significantly larger than the typical size of bacteria particles. In the present embodiment, however, it is recognised that when the fibres are coated with a sticky anti-bacteria liquid,
20 mesh sizes selected around 150 microns become suitable, because the large pore sizes allow fast airflow, while presenting a sufficiently tortuous and random flow-path that ensures that 100% of the bacteria will impinge on one of the fibres, and adhere thereto because of the sticky coating.

The weave, selected around 150 microns, thus, uses a different mechanism to trap the bacteria. The bacteria are not necessarily only caught between the gaps of two proximate fibres (as per the analogy
25 of fish caught in a net). Rather, the weave of the fibrous matrix, at a 150 micron weave, is found to present a sufficiently tortuous path, that the probability of a bacteria hitting or colliding with a fibre is extremely high. Also, as will be described below, the filter strands are coated with a sticky material to ensure that the bacteria particles, which do collide with a filter fibre, are more than likely to cling to the fibre, rather than carry on with the airflow. In other words, in a filter mesh or around 150 microns, the
30 large gaps in the fibres enable the airflow to move very quickly through the filter material. At the same time, the density of fibres at 150 microns ensures that the bacteria in the air are captured by the filter threads as the air moves through the filter.

In other words, it is the nature of the fibrous material, plus the sticky coating on the fibres, that combine to address both the conflicting requirement of i) germ capture, and ii) airflow speed.

35 While filters of around 150 microns are, of course, widely available in the market for general use, it is the unforeseen selection of a filter mesh around 150 microns that gives the unexpected result of enabling both i) 100% germ capture and ii) very high airflow speed. The selection of around 150 micron mesh is unexpected because the large pore size is many multiple times larger than the typical bacteria size. The selection, used for the present embodiment, recognises that this seemingly large filter pore size
40 actually and unexpectedly becomes an ideal choice, if it is combined with the sticky coating.

5 Some experimentation may be done to determine the upper and lower limits of acceptability, in terms of plus-or-minus variance from the 150 micron mark that can still achieve the dual and unexpected benefits of enabling i) 100% germ capture and ii) very high airflow speed.

 The main filter material 410B traps and retains, in the filter, a substantial portion of the bacteria particles in the airflow. Thus, the airflow leaving the main filter 410B is more sterile than when it enters
10 the filter 410B.

 In the above paragraph, the word "retains" indicates that a substantial portion of the bacteria enters, but is unable to leave the filter. In other words, the airflow leaving the main filter 410B has numerically fewer particles of bacteria than the airflow entering the same main filter 410B.

 A feature of the present embodiment, that has been verified by independent microbiological
15 testing, is that the airflow leaving the filter 410B is fully 100% bacteria-free or at least substantially bacteria-free and extremely close to the 100% mark. In other words, the bacteria particles have not merely been inactivated or killed, but have been physically removed from the airflow to a very substantial degree.

 An early experimental model of the embodiment was tested in a male washroom of an industrial
20 factory, in which aerial contamination with different micro-organisms was verified to be present. The airflow emanating from the dryer 1 was found to be 100% free of bacteria particles or pathogens. Thus, the bacteria-entrapment-filter-means of the embodiment is able to trap 100% of the bacteria in the airflow, such that the airflow leaving the bacteria-entrapment-filter-means is, or substantially close to 100% bacteria-free.

25 It would be evident, therefore, that the embodiment of the present invention which can achieve the goal of 100% bacteria-free hand drying would be arguably more hygienic for drying hands than even disposable paper towels. For instance, the model which achieves this close to 100% bacteria-removal would be suitable for use by surgeons prior to attending to surgery.

 Thus, in this aspect of the invention, the embodiment of the dryer 1 is provided with a means of
30 entrapping and retaining the actual bacteria particles, so as to prevent the bacteria from leaving the dryer in the warm airflow 200C. This is conceptually different to air filters, used in prior art dryers, which merely filter out larger particles such as dust and grit, and which are not adapted or even intended to entrap the bacteria on a scale of 100% removal of the bacteria particles. Thus, any prior art that recites merely an "air filter" should not necessarily be treated, prima facie, as a prior disclosure of a bacteria-
35 entrapment-filter-means unless it teaches the actual entrapment of the bacteria particles.

 A broad premise of the embodiment is that, in order to kill the bacteria effectively, the bacteria particles have to be entrapped. This is a different approach to those prior art sterilising dryers that attempt to kill the bacteria while the bacteria is entrained in the swiftly moving airflow, without first trapping and retaining the bacteria particles. In experiments, it has been found that such prior art systems are far less
40 effective at removing bacteria from the airflow, compared to experimental embodiments of the present

5 embodiment which, firstly, entrap the bacteria, and then secondly kill the entrapped bacteria which is held motionless in the filter.

 In summary, the fibrous matrix is able to physically capture bacteria particles and, at the same time, also to present minimal impedance to the airflow. Hence, the average gaps or pores between the fibres that are very significantly larger than the size of bacteria so as to present minimal impedance to the
10 airflow. Also, a tortuous path for the airflow created by the fibrous matrix so that the bacteria particles have an extremely high probability of impacting at least some of the fibres of the matrix.

Example of filter material

15 As an example, the filter material used in the present embodiment is a carded polyester spun-bond membrane with multiple random fibres of 150 grams per metre square. The filter material has a calliper thickness of 1.4 to 1.8 mm. This relatively large pore size, in the 150 gsm filter material, allows a maximum air velocity permeability of 2500 l/sec/m².

 This material, when in the dry state, provides a degree of fibre entanglement with average gaps
20 or pore sizes of around 30-40 microns. Thus, in a dry state, this material is inadequate for achieving 100% bacteria capture, because the bacteria particles are usually 0.3 to 30 microns, and viruses are between 0.01 and 0.05 microns. Hence, in its dry state, the 150 gsm filter material is, in itself, unlikely to be suited to achieving the goal of 100% capture rate or close to that. However, the selection of such an apparently unsuitably large mesh size, when combined with the sticky coating on the fibres, is unexpectedly able to
25 be used in achieving the goal of 100% capture rate, while still enabling fast airflow speeds through the large pore sizes.

 The added stickiness of the coated fibres enhances the ability to entrap particles many times over the normally expected capture rate that would be suggested merely from the 150 micron pore size alone.

30

Bacteria-Killing Substance: Killing The Germs In The Filter

 In the preferred embodiment, the filter material 410B is coated with a bacteria-killing substance that is able to kill the bacteria entrapped and retained therein.

35 The fibrous matrix has, on its fibres, a toxic bacteria-killing substance which is able to kill any bacteria that impinges on the bacteria-killing substance on the fibres.

 Thus, a substantial portion of the bacteria, that is trapped and retained in the filter, is also killed in the filter, on the fibres. (If there were no anti-bacterial material in the filter, the entrapment of bacteria particles would lead to an bacterial-infestation in the filter material).

40 In the embodiment, it is an advantage that the germs or bacteria are entrapped, and then killed while they are in the filter. Otherwise, if the germs were merely entrapped, but not killed, then bacteria

5 levels in the filter would gradually increase over time. Then, when the machine is turned off or not in operation, bacteria on the filter would grow, such that the filter itself would become a source of bacteria that could spread throughout the apparatus to infect the internal surfaces.

The anti-bacteria material, which is used to kill the bacteria, may be in the form of liquid or gel, provided it performs the role of killing the bacteria that is entrapped in the filter.

10 In practice in the embodiment, the bacteria-killing substance is sprayed onto the fibrous filter material within an alcohol-based liquid spray. When the alcohol evaporates, the bacteria-killing substance remains on the fibrous, random matrix.

In the embodiment, the bacteria-killing substance is a liquid-applied substance. When the bacteria-killing substance is applied as a liquid to the fibre, it forms a sticky coating on the fibre which
15 aids in the capture of bacteria that impinges on the bacteria-killing substance found on the fibres. The sticky coating is able to physically hold the impinging bacteria particles to the fibre so that the bacteria are held and killed in that location.

It is appreciated that any number of anti-bacterial materials or liquids can be used to kill the bacteria particles that are entrapped in the filters 410B, 520B. In the present embodiment, the substance is
20 manufactured by Healthguard Corporation of Campbellfield, Victoria, Australia, bearing product code: AFA-BK, 9-260.

In the embodiment, the entrapment filter 410B should be changed each month, since the potency of the anti-bacterial sticky material on the filter does not maintain its effectiveness for extended
25 periods.

Further Modifications: Filter Arrangement

In the first embodiment of Figure 4, there is one main filter 410B in the main-filter assembly. In that first embodiment, while the anti-bacteria material kills bacteria that impinges on the filter 410B, a
30 disadvantage is that traces of the anti-bacteria material can remain in the airflow, and exit the filter into the atmosphere of the human-activity environment. Although these minute trace amounts anti-bacteria material are unlikely to be dangerous to the average person, these can be highly dangerous to some people, particularly those who suffer from respiratory or lung ailments. For example, people who suffer from cystic fibrosis can be harmed by even trace amounts of toxic materials in the atmosphere.

35 The anti-bacteria liquid, when it is at the level of potency that can kill 100% of the typically most virulent bacteria, tends to be very poisonous and harmful to humans. For example, it is potentially an eye-irritant.

The bacteria-killing substance is required to be highly toxic in order to kill the bacteria, but preferably the toxins need to be removed from the airflow.

40 In order to remove any trace amounts of toxic material from the airflow, Figures 7A and 7B show that the main fibrous filter 410B, which has the a toxic bacteria-killing substance, is followed in

5 sequence by a charcoal or carbon filter-means. In the embodiment, the charcoal filter-means is the form of a charcoal-infused fibrous or porous filter material 410D that is infused with charcoal or carbon particles.

The charcoal or carbon particles, in the charcoal-infused filter material 410D, intercept and remove from the airflow any of the toxic bacteria-killing substance that originates from the coating on the entrapment filter 410B. This ensures that the airflow leaving the main filter assembly is substantially free, not only of bacteria particles, but also of traces of the bacteria-killing substance.

Removal of the bacteria-killing substance from the airflow, as mentioned above, enables the apparatus 1 to be used in human-activity environment where there are people with very sensitive lung conditions, such as in hospitals.

15 Also, since the bacteria-killing substance is removed from the airflow, this allows the option to use of much more highly potent bacteria-killing substances on the first fibrous filter 410B. This because, without the subsequent charcoal filter 410D, it would have been necessary to refrain from using extremely toxic materials in the first filter 410B, for fear that the greater toxicity in the airflow might harm people in the surrounding environment. Whereas, with the subsequent charcoal filter 410D, the use of much more highly toxic substances in the first filter 410B enables the apparatus to achieve greater effectiveness in its bacteria-killing capacity. In the embodiment, this ability to use much more highly toxic materials, due to the presence of the charcoal filter, contributes to the ability to achieve a 100% bacteria-free airflow emanating from the apparatus 1.

Furthermore, without being limited to theory, it is believed that the charcoal re-oxygenates the airflow as it flows through the charcoal-infused filter 410D.

Thus, the charcoal is believe to have the dual roles of, firstly, removing the toxic anti-bacterial chemical, and, secondly, re-oxygenating the airflow. The charcoal is also believed to remove malodours and smells from the airflow.

In the embodiment, a fibrous filter material 410D is infused with charcoal particles or powder, however, in other modifications, highly porous pieces of charcoal or charcoal-infused material, may also be used, provided the porosity is sufficient to not substantially impede the airflow velocity.

In the embodiment, it is not intended that the charcoal filter 410D be primarily used to trap and kill the bacteria. The step of trapping and killing the bacteria is performed in the first entrapment filter 410B. Hence, the airflow that comes from the entrapment filter 410B would have reached the 100% bacteria free level, or at least virtually at that level, at the point where it enters the charcoal filter 410D.

In fact, charcoal or carbon is believed to be an inferior material for trapping and killing the bacteria. Without being limited by theory, it is believed that the charcoal is not as suitable a substrate on which to place the bacteria-killing substance, perhaps because the bacteria-killing substance may be absorbed inside the charcoal particles, rather than letting the bacteria-killing substance remain on the surface to be available to kill the bacteria. Also, it is postulated that the charcoal particles may contaminate the bacteria-killing substance, which, in the embodiment, is a liquid or liquid-applied

5 substance. In summary, the charcoal filter 410D in the embodiment is not adapted to perform the step of killing the bacteria.

Since the charcoal filter 410D, in the embodiment, does not contain the sticky anti-bacterial liquid coating, the 100% removal of bacteria from the airflow should have been achieved before the airstream reaches the charcoal filter 410D. If not, then it implies that some bacteria could be reaching the charcoal filter, and this bacteria could multiply when the airflow is not operating. That could lead to the charcoal filter, over time, turning into a source of bacteria. Hence, the 100% removal of bacteria must occur before the airflow reaches the charcoal filter.

Filter housing – bacteria cannot enter

15 In the second embodiment of Figure 7A (in similar manner to Figure 4), the base element 410A of the filter assembly is adapted to fit directly into the main entrance or main aperture 405 of the fan-casing.

In the exploded view of Figure 7A, the first filter holder 410C, in turn, fits onto the base element 410A, followed by a second filter holder 410E which, in turn, fits onto the first filter holder 410C.

Figure 7B shows the components of Figure 7A in an assembled state. The assembled parts fit together with a bayonet-style engagement, although other forms of attachment mechanisms are possible in other embodiments.

25 In Figure 7B, an arrow 409 shows the direction of the airflow when the apparatus 1 is in use. In Figure 7B, the filter arrangement is provided with filter-barrier-means which, in the embodiment, includes the walls of the filter holders which, when assembled, fit very tightly together. It also includes the barrier created by the interface of the lower edge of the base element 410A and the fan-housing.

The walls of the filter holders 410C, 410E, when fitted together in use, serve to house the main entrapment filter 410B and the charcoal filter 410D. The net effect of the filter-barrier-means is to provide a bacteria-impermeable barrier for the filters 410B, 410D. This effective bacteria-impermeable barrier separates the filters 410B, 410E from the interior of the apparatus. This means that, when the airflow is blowing through the apparatus 1 and even when it is not, bacteria or other contaminants inside the apparatus can only enter the filter arrangement via the face of the main filter 410B that directly faces the incoming airflow. The contaminants and bacteria cannot pass through other parts or joints of the filter arrangement.

In the embodiment of Figures 1A to 4, the airborne-bacteria filter arrangement 410A, 410B, 410C, 410D, 410E is located fully inside the interior of the apparatus 1.

When the base element 410A and the filter housings 410C, 410E are fitted together, bacteria cannot enter into the interior of the filter arrangement through points of abutment of the components 410A, 410C, 410E, due to the bacteria-impermeable barrier that results from the tight fitting of the

5 components. This is an advantage because, potentially, the interior surfaces of the apparatus 1, like any machine, are a potential source of contaminants, whether from the materials from which they parts are made, or from bacteria that enters the machine in spite of safeguards described herein. Hence, the bacteria-impermeable barrier prevents entry of bacteria through the sides or joints of the filter assembly (410A to 410E).

10 Also, the same bacteria-impermeable barrier prevents any live bacteria inside the filter arrangement from escaping into the interior of the apparatus when the apparatus is turned off, or not generating an airflow. For instance, bacteria might enter through the grille 15, in Figure 1A. For instance, when the apparatus is not in use, the bacteria-impermeable barrier prevents bacteria from entering into the interior of the apparatus. This avoids the interior of the apparatus itself eventually becoming a source of
15 bacteria. (When the machine is turned off, the main filter 410B prevents bacteria, entering via the opposite, end passage 14, from reaching the internal regions of the apparatus. Once the apparatus is turned on again and used, any bacteria in the end passage 14 would tend to be killed by the heat from the heating element 300).

This creation of the bacteria-impermeable barrier, in the surfaces of the filter arrangement,
20 complements the function of other features of the apparatus which, individually and/or in combination, act to prevent, as far as possible, bacteria from entering into the interior of the apparatus. This is to avoid or minimise a situation where the interior of the drying apparatus 1 could itself become a source of bacteria.

These features, which minimise the entry of bacteria into the interior of the apparatus,
25 contribute to the ability of the apparatus 1 to achieve 100% bacteria removal from the airflow. In other words, the prevention of bacteria entry into the interior, even when the apparatus is not generating an airflow, is another factor that can influence whether the apparatus, overall, is able to achieve the goal of 100% bacteria removal.

It has been described above that the main filter arrangement 410A to 410E, in this embodiment,
30 is positioned and located at the final entry point to the fan-housing 400. In combination with this fact, the provision of a bacteria-impermeable barrier for the main filter arrangement, further ensures that bacteria cannot pass through the main aperture 405 through gaps or joints in the filter assembly, except and only through the front of the main filter 410B.

In other modifications, the mechanism for fitting the components of the filter assembly together
35 may be designed so that, once fitted, the components cannot be pulled apart by the user. Some form of locking mechanism may be provided. This is to ensure that the user does not inadvertently open up the filter assembly, thus releasing any bacteria therein. The intention, for such an embodiment, is that the entire filter assembly 410A to 410E is replaced periodically, as an entire unit. In the present embodiment, it is recommended that the filter assembly be replaced at least once a month.

5 It is noted that, in some cases, particularly in non-medical ambient environments, the use of the charcoal filter may not strictly be required. People with a general state of health may tolerate the low trace levels of the bacteria-killing substances in the airflow that emanates into the surrounding atmosphere.

10 Integral Unit: Replacing & Disposing of Filter and its components

From Figures 3, 7A, 7B, 8A, 8B, and 1B, the filter arrangement, when assembled, is in the form of an integral and single unit. In other words, all the relevant components of the filter arrangement are contained in a single replaceable and disposable unit. When the main filter 410B starts to become filled with captured and killed bacteria particles, the entire main filter arrangement can be removed as a single entity, and replaced. This is an advantage because the ability to conveniently replace the main filter assembly ensures that it does not itself become a source of bacteria when the filter starts to be clogged with bacteria particles that have been entrapped and killed. It is not only the fibrous filter material that needs replacing, but also the surrounding components that are also tainted by bacteria. Such an advantage would not be present in prior art apparatus where components are spread around the machine as separate components.

Integral Unit: Replacing & Disposing of Internal Surfaces of the Apparatus

25 This ability to remove and replace a single unit can be appreciated in another light. Not only does this enable the replacement of the filter elements 410B, 410D, but, just as importantly, it enables the removal and replacement of the "internal surfaces" 412 of the apparatus 1 that are closest to the final entry point to the final aperture 405. It ensures that these internal surfaces 412, themselves, do not, over months or years of use, become coated with bacteria or other contaminants.

30 This recognises the fact that the design of an apparatus must be assessed for its potential performance over years of use, not just as it functions when new. Over years, the internal surfaces of the machine can become contaminated with bacteria too. That adds another factor to the difficulty of achieving 100% bacteria removal from the airflow over the long term use of the apparatus, which can be in operation for many years.

35 Thus, the ability to replace the critical internal surfaces of the apparatus, that are closest to the final aperture 405 is another factor in the embodiment that contributes to the ability to achieve 100% bacteria removal, not simply in a new apparatus, but over years of use.

40 In prior art apparatus, while the component that are spread around the apparatus may possibly be removable, it is very difficult to replace internal surfaces. In the present embodiment, it is therefore an advantage that this sealed environment, created within the main filter arrangement, can be removed and replaced as a single unit. Critical internal surfaces, that lead towards the final aperture, can be readily

5 replaced. This ensures that the internal surfaces, that are downstream of the final entrapment filter 410B, do not themselves, over time, become sources of bacteria.

In Figures 7B, 8B, 9A and 9B, the main entrapment filter 410B and the charcoal-infused filter 410D are separated by a volumetric region, in the form of a volumetric gap 413. The gap 413 is sealed within the bacteria-impermeable barrier. The volumetric gap 413 acts as an interim destination for the
10 airflow to enter after leaving the entrapment filter 410B. Without being limited by theory, it is believed that this confined volumetric gap 413 helps to maintain the airflow within a confined area, rather than diffusing over a wide cavernous volume that could add to air turbulence and decreased airflow speed.

The main entrapment filter 410B and the charcoal-infused filter 410D, when there is no airflow passing through, are generally parallel to one another such that the volumetric region therebetween is a
15 flat and planar-like.

The airflow leaves the main entrapment filter 410B and enters the charcoal-infused filter 410D in a manner that the airflow is substantially perpendicular to the surfaces of each of the filter-means.

In Figure 7A, the height of the rim of each filter component determines the distance of the gap 413 between each filter component. It is believed that the distance between filter pieces affects the ability
20 of air to flow through the overall filter arrangement. This is because the same filter materials 410B, 410D, placed together as a single, thick sandwich of filter materials, without gaps, would not allow the same speed of air-flow.

The charcoal filter 410D should be relatively close the entrapment filter, so that substantially all the anti-bacteria toxic material from the main filter 410B can be intercepted. Otherwise, if the charcoal
25 filter 410D were separated from the entrapment filter 410B by a very great distance, then, over a period of years, the internal surfaces of the apparatus in between the main entrapment filter 410B and the charcoal-infused filter 410D could see a steady build-up of the toxic anti-bacteria chemicals on its internal surfaces. Thus, it is an advantage for the gap 413 to be as small as possible. A small gap 413 ensures that the airflow coming out of the main filter 410B, will enter almost immediately into the charcoal filter
30 410D, with less chance of depositing the toxic anti-bacterial liquid on internal surfaces of the apparatus.

Emitting a substance

By way of brief review, the airflow enters the filter arrangement via the entrapment filter 410B
35 where the bacteria is trapped and killed by the anti-bacterial liquid that is coated on the fibres. Next, in sequence, the airflow coming out of the filter 410B enters a charcoal-infused filter 410D where any traces of the anti-bacterial liquid, in the airflow, are removed.

In the third embodiment of Figures 8A and 8B, following after the two filters 410B, 410D, there can an emitting-filter-means in the form of an effusing filter 410F held in a third housing 410G.

40 The purpose of this effusing filter 410F is to add or infuse into the airflow some emittable-substance that has some manner of benefit. For example, the beneficial emittable-substance may be a

5 pharmaceutical that is able to be administered to a user in an airborne manner. In one example, the pharmaceutical could be a medicinal substance used by people who suffer from asthma. Typically, people who suffer from asthma use an inhaler to breathe in medicinal vapour, however, an embodiment of the present invention can be used to infuse that substance into the ambient atmosphere, so that the pharmaceutical can be breathed in continuously in smaller trace amounts. This approach can be used in
10 relation to other breathing disorders, such as bronchitis and sinusitis. Potentially, any ailment that is treated by a person breathing in a vapour, can be delivered by effusing that substance into the air.

Alternatively, the beneficial emittable-substance may be a fragrance. This is useful when the apparatus 1 is used in environments that have unpleasant odours, such as in public toilets, where there is a need for air-freshening substances to be infused into the atmosphere. This has particular application to the
15 field of aromatherapy.

In the case of a hand dryer used in medical fields or in other washrooms, even though the highly toxic bacteria-killing substances, that come from the main filter 410B, should preferably be removed from the airflow, this subsequent effusing filter 410F can emit a less-toxic anti-bacterial substance, which is less potent compared to the highly toxic substance found on the entrapment filter 410B. This less-toxic
20 substance can be directed onto the user's hands as the hands are dried. This would provide additional anti-bacterial treatment for the hands.

In the embodiment, the use of a less-toxic anti-bacterial substance, emitted from the effusing filter 410F, also performs an added role of killing or minimising the amount of bacteria that enters the apparatus 1 via the end-opening 14.

25 As described below, each beneficial emittable-substance can be used in combination with a chemical release agent.

Fluttering Filter

30 Figures 9A and 9B show an embodiment where filters are installed inside their filter housings, with Figure 9A being when there is no airflow, and Figure 9B when an airflow passes through.

In the embodiment, the filters, as mentioned, are in the form of a flat piece of filter material that is mounted loosely on a pin 411. The loose mounting of the filter on the pin is such that the filter is able to flutter in the airflow, as shown diagrammatically in Figure 9B. Without being limited to theory, it is
35 believed that this fluttering of the effusing filter 410F assists in effusing the emittable-substance, from the fibres of the filter 410F, into the airflow.

Acceptable Filter Sequences & Combinations

40 Various embodiments of the invention can have a range of acceptable sequences and/or combinations of filters.

5 In all embodiments of the filter arrangement, a main bacteria entrapment filter 410B is essential.

For certain medical environments, it is preferred that the entrapment filter 410B is followed by the charcoal-infused fibrous filter 410D, and in other human-activity environment where there are people who may be adversely sensitive to even trace doses of the highly toxic bacteria-killing substance used in
10 the main entrapment filter 410B.

In other embodiments, where there are unlikely to be many people with adverse sensitivity to the trace doses of the toxic bacteria-killing substances, the charcoal-infused fibrous filter 410D may be omitted. For example, in such cases, the effusing filter 410F can follow after the entrapment filter 410B as the next filter in sequence.

15 Also, in other environments, the effusing filter 410F may not be required, and here it would be sufficient to have just the entrapment filter 410B, and sometimes followed by the charcoal-infused fibrous filter 410D, where necessary.

Filter Sequences & Combinations: Four Filters

20 Figures 8C and 8D show a fourth embodiment where the filter arrangement includes four filters 410B, 410D, 410F, 410FF in sequence.

In Figure 8C and 8D, airflow through the filter arrangement first encounters the main entrapment filter 410B and the charcoal-infused filter 410D. Following these are two effusing filters
25 410F, 410FF.

In the embodiments, when there are two or more effusing filters, 410F, 410FF, each effusing filter preferably contains a different beneficial emittable-substance.

For example, the next filter 410F in the sequence could effuse a fragrance or perfume into the air, while the ultimate filter 410FF in the sequence could emit the less-toxic anti-bacterial substance.

30 Therefore, in the four-filter embodiment of Figure 8C:

i) the bacteria in the airflow is entrapped by the filter and killed by a poisonous, highly toxic anti-bacteria substance on the first filter 410B;

ii) the poisonous anti-bacteria substance is removed from the airflow by the charcoal-infused filter 410D;

35 iii) a fragrance or perfume from a penultimate effusing filter 410F is evaporated into the airflow; and

iv) a mist of mild anti-bacterial substance is effused into the airflow by the ultimate effusing filter 410FF, so that the airflow emanating from the apparatus will contain a mild non-toxic anti-bacterial substance.

40 It is noted that some substances are effused into the airflow by the substance fully or substantially evaporating into the airflow. In contrast, there are other substances that are effused into the airflow as

5 minute particles or a fine mist of liquid. For instance, in the previous example, a perfume or fragrance is likely to evaporate into the airflow, whereas effusing some types of mild anti-bacterial substance into the airflow is more likely to happen in the form of a fine mist entering the airflow.

Therefore, when there are two or more effusing filters 410F, 410FF, and when one of these has an evaporating substance and the other has a mist-creating substance, it is preferred that the airflow first
10 encounters the filter 410F with the evaporating substance, followed by the filter 410FF that has the mist-creating substance.

This sequence and arrangement is recommended because, if the mist-creating substance were to be on the penultimate filter (410F in Figure 8A), then the mist is likely to be trapped or collect on the ultimate filter (410FF) instead of passing out into the ambient environment.

15

Filter Sequence Mechanism to ensure Acceptable Filter Sequences

In order to ensure that the components in the filter arrangement are arranged or fitted together in the desired sequence, each of the filter holders are provided with a mechanism that can engage with
20 another filter holder only in a predetermined acceptable sequence. Each of the filter-holders 410C, 410E, 410G is provided with attachment-sequence-means that ensure that the filters can only be attached one to the other in the aforesaid sequence.

The attachment-sequence-means on each filter-housing is in the form of a shaped contour that can only mate precisely with a corresponding contour on the filter-housing that is next in any one of the
25 acceptable sequences. In Figure 7B, the attachment-sequence-means is in the form of a bayonet-style mount. The dimensions and position of the bayonet mount on each of the housings 410C, 410E, 410G are designed to ensure that unacceptable combinations cannot possibly occur, as described above.

For instance, the embodiment of the filter arrangement cannot have the charcoal-infused fibrous filter 410D being the first filter in the sequence. Hence, the filter housings 410C, 410E, 410G are
30 designed with connectors that can only mate or connect with another of the filter housings, in an acceptable combination.

For example, an acceptable combination would be seen in Figure 7B where the rear of the main filter housing 410C is able to mate or connect with the front of the housing 410D for the charcoal-infused filter.

35 In other embodiments, the attachment-sequence-means could be in the form of pins on one filter housing that can only mate with another of the filter housings when there is a corresponding pin-hole. The location of the pins and pin-holes are located to ensure that only the acceptable sequences of connection are possible.

When each of the filters holders are attached one to the other in an acceptable sequence, the
40 filter-holders combine to create the bacteria-impermeable barrier, discussed above.

5 The filter-holders also fit together in an acceptable sequence to form a single stack, also discussed above.

Secondary Filter or Filters

10 In the embodiment of Figure 1A and 1B, in addition to the main filter assembly 410A, 410B, 410C and also preferably 410D to 410G, it is preferable for the inlet-means to also include one or more secondary filters arranged in series with the main filter arrangement 410A to 410E/G.

15 In the embodiment in Figure 1A, a secondary filter 520B partially reduces the amount of bacteria in the airflow, but not all of the airflow passes through the secondary filter. For instance, in the embodiment, when there is no rubber strips to seal the gaps between the hood 10 and the baseplate 11, some airflow can enter the dryer 1 through these gaps, and, as a consequence, allow entry of bacteria through the gaps. That is the reason why, in the embodiment, the external filter 520B is regarded merely as a “secondary filter”.

20 Maintaining Airflow

 Each of the one or more secondary entrances 520D is provided with a bacteria-entrapment-filter-means (520B). It stands to reason that having more than one filter increases the overall combined “thickness” of filter material that the bacteria has to pass through, thus increasing the likelihood of the bacteria being entrapped by the filter material.

 In the embodiment of Figure 1A and 1B, the air, which enters the housing 10, 11, eventually reaches the heating elements 300 after it passes through a series of apertures. (The initial secondary aperture 520D is obscured in Figure 1A, since this aperture 520D is shown with the secondary filter assembly 520A, 520B, 520C in exploded view, indicating how the three parts of the secondary filter-assembly fit into this aperture 520D).

 The coarse mesh of the secondary filter holders 520A, 520C are useful for filtering out large dust and other particles. Other embodiments can have more than three layers comprised in the secondary filter assembly.

 The secondary filter 520B, located at this initial aperture 520D, stops a substantial portion of the bacteria particles entering the inlet-means of the dryer. In practice, however, not all bacteria particles are entrapped by this secondary filter 520B, and moreover, further bacteria can enter the dryer 1 through gaps in the housing 10, 11, and even when the hood 10 is open. Therefore, the main filter 410B, on the main aperture 405, is used to entrap any bacteria in the airflow that eludes entrapment by the initial secondary filter 520B.

40 It is logical that the greater the thickness of filter material that the airflow has to pass through, the greater the likelihood that the airflow-borne bacteria will be entrapped. However, it is not a viable

5 solution simply to increase the thickness of the main filter 410B found on the internal fan-casing 400. This is because the operation of the fan 401 requires a certain input or throughput of air as part of the operational parameters of the fan. If the main filter 410B were simply to be thickened, then it could lead to a lower rate of air entering the fan-casing, which would most likely lead to overheating and degradation of the fan mechanism, and can even cause the fan motor to catch fire.

10 Therefore, rather than simply increasing the thickness of the main filter 410B, it is preferable to have two or more entrapment filters in series, so as to effectively increase the amount of filter material through which the airflow has to pass. In other words, to have one or more secondary filters 520B through which the airflow passes before coming to the main filter 410B.

15 Alternatively, in embodiments where there are a series of entrapment filters, these can also be achieved by adding further multiples of the entrapment filter components 410B, 410C. The series would be achieved by adding to the stack of components. In other words, it is better to have several entrapment filters in series, rather than having one single entrapment filter of great and equivalent thickness.

In the embodiment, the secondary filter 520B may also be regarded as being in series with the main filter 410B because the airflow passes through each of these filters, one after the other, in sequence,
20 or in series, as it were.

By way of background, the fan assembly 401 acts as an air-pump that the sucks air from within the housing 10,11 into the pump. To maintain the rate of airflow produced by the fan 401, there must be a sufficient body of air for the fan to suck in. This is why the housing 10, 11 is provided with a sizeable interior, so that a sizeable body of air can be located proximate to the fan assembly. This is also why the
25 main aperture 405 and the main filter assembly 410A, 410B, 410C are separated from its next nearest entrance in the series, namely the initial secondary aperture 520D and its filter assembly 520A, 520B, 520C, by a substantial space in the housing that contains sufficient air to satisfy the air intake requirements of the fan 401 assembly, in terms of volume of air per unit time.

30 Benefit of Series Of Filters

In the embodiment, at least one secondary entrance 520D may be located on an external surface of the housing 10, so as to be accessible by the user from outside of the housing. Figure 1A shows the assembly 520A, 520B, 520C of the secondary filter in exploded view, indicating that its components can
35 be accessed and replaced from outside of the housing 10.

In the embodiment of Figure 1A and 1B, which has an inner main filter 410B and an external secondary filter 520B, it is found that the external filter 520B traps most of the dust and large particulate. This leaves the main inner filter 410B to be used mostly for entrapping the bacteria particles.

In experimental tests, it is found that, with the secondary filter 520B alone, the dryer 1 is
40 capable of achieving around a 79% reduction in bacteria particles in the airflow that is emitted from the

5 dryer. It is believed that this loss of efficiency is because some bacteria enters the housing 10,11 through the fine gaps between the edge of the hood 10 and the baseplate 11.

However, with the combination of the main filter 410B located at the final entrance 405 of the fan-housing, plus the secondary filter 520B, experimental tests show the dryer 1 is capable of reaching the goal of 100% removal of the bacteria particles from the emitted airflow 200C.

10 In those modifications where the main filter is on the surface of the hood 10, and where this is the only filter arrangement, the preferred 100% bacteria reduction can be achieved, preferably when all other gaps or entrances into the housing are sealed in use. For instance, the gaps between the housing 10 and the base plate 11 can be fitted with rubber gaskets, so that a seal is created when the hood 10 is closed and pressed against the baseplate 11, however, this modification is less effective when the hood is opened
15 to introduce bacteria into the apparatus. In other words, in the embodiment, all gaps in the housing, that are not intended by intent and design for the airflow path of the apparatus, are sealed to such a level to prevent bacteria entry.

For the avoidance of doubt, the airflow path of the apparatus, which is by intent and design, is characterised by those apertures that are provided with the intent to allow airflow therethrough, and does
20 not include unintentional gaps through which air can enter unintentionally.

In other embodiments, the secondary filter holders 520A, 520C can also hold a wad of material that contains a fragrance. In other embodiments, the secondary filter can carry both a fragrance-carrier, as well as a filter material impregnated with anti-bacteria, killing material.

25 Filter Replacement

In the present embodiment, the filter actually entraps the bacteria particles and kills the entrapped particles. Consequently, the filter can, over a period of time, become clogged with dead bacteria particles. Hence, in the embodiment of Figure 1A, it is advisable for the filter or filters 410B,
30 520B to be replaced each month.

In actual practice, it is possible that the person, who is responsible for maintenance of the dryer, may forget to replace the filters as frequently as required for optimum operating conditions. If the filter is not replaced, such that it becomes clogged, this may cause damage to the motor. For instance, the motor can overheat because the clogged filter allows less air to reach the motor that the motor requires to keep
35 from overheating.

Hence, in modified embodiments in Figures 6A and 6B, the bacteria-entrapment-filter-means includes a filter-replacement mechanism that is able to automatically replace the filter material, in use, with replacement filter material.

In the embodiment of Figure 6A, the filter-replacement mechanism includes a spool-motor 700.
40 In Figure 6A, the filter material is in the form of a loop of sheet-like filter material 440B that travels around and around the spools 710 in a manner similar to a conveyor-belt.

5 The sheet-like filter material 440B traverses across a secondary aperture (not shown) in the hood 10 of Figure 6A, so as to act as a filter for that secondary aperture. Thus, over a period of time, as the filter material 440B moves across the aperture, the filter material in use is replaced with replacement filter material periodically after a period of time.

10 In other embodiments, the sheet-like filter material 440B may be adapted for use in the main filter assembly.

 The movement of the spool-motor 700 is controlled by a micro-processor control circuit which controls the timing and motion of the spool-motor. The motor 700 can move the filter material 440B either continuously or intermittently. For instance, the motor can move the filter material once every month, so that the filter material which covers the aperture is effectively replaced each month.

15 Alternatively, the motor 700 can move the filter material 440B progressively with a constant, very slow motion. This enables a greater amount of filter material to participate in the filtering process. Assuming this filter material 440B is also replaced often, say, once a month, it would mean that this form of cycling filter would have less likelihood of being clogged.

20 The embodiment is provided with a guide to ensure that the filter material is held taut against the aperture.

 Figure 6B shows another variation, in which the sheet-like filter material 450B is formed like camera roll-film which rolls from one spool to the next, eventually coming off the first spool 710A, at which point the air would pass un-filtered into the housing 10, 11. This means that the user, who is responsible for maintenance, has to change the filter on time before the filter has totally spooled onto the

25 second spool 710B. The advantage of this variation, however, is that the filter is unlikely to be clogged to the degree that would lead to damage and overheating of the fan-motor 430.

 It is noted that Figures 6A and 6B have been drawn briefly, only to show details of embodiments of a filter-replacement mechanism, and for the sake of simplicity, other internal details of the dryer, such as the fan-casing etc., have been omitted from Figures 6A and 6B.

30

Safety Features

 In the embodiment of Figure 1A, the internal main filter assembly 410A, 410B, 410C of Figures 1B and 3 can only be replaced by opening up the housing to reveal the inner components within the

35 housing.

 As a general comment, which pertains to hand dryers of this art, the step of opening up the body or housing of a hand dryer, by a user untrained as an electrician, can increase the risk of the user being electrocuted.

 In the embodiment of Figure 1A, the dryer 1 has an electric control circuit which supplies

40 electrical power to the dryer 1. The electrical control circuit is provided with a cut-off mechanism that

5 disables the supply of electrical power when the housing is opened so as to minimise risk of the user being electrocuted when opening the housing.

In Figure 1B, the cut-off mechanism is in the form of a resiliently-mounted switch 501 which enables the supply of electrical power only when depressed.

10 Figure 2A shows the embodiment of present embodiment with its hood 10 in a closed state, while Figure 2B shows the same with the hood 10 in an open state. In this open state of Figure 2B, the user is able to access the internal components, and particularly is able to change the internal main filter 410B.

15 To remove the risk of the user being electrocuted, the interior of the hood 10 is provided with cut-off-mechanism-activator or an actuator in the form of an upstanding post 502. From comparing Figure 2A with Figure 2B, it is evident that, when the hood is closed, the switch 501 is depressed by the tip of the post 502. Whereas, then the hood is opened, the tip of the post 502 lifts off the switch 501, thereby disabling the supply of electrical power to the dryer 1.

The switch 501 is located and mounted on the baseplate 11. The hood 10 of the housing is removably attachable to the baseplate 11. The post 502 is mounted on an interior surface of the hood.

20 In an alternative embodiment, the depressor (post) may be mounted on the baseplate, while the switch may be mounted on an interior surface of the hood.

25 The feature of the cut-off mechanism contributes, at least in part, to achieving the goal of a sterilising hand-drying apparatus that emits a stream of heated air that is preferably 100% bacteria-free. This is because it allows for an internal filter 410B that can be replaced by a user, without risk of electrocution when exposed to the internal components. Hence, it provides a safer environment where a series of filters can be housed in the dryer.

Installation Of The Dryer

30 In the embodiment of Figure 1A, the base-plate 11 is fastened to a wall, for example. The dryer 1 can be installed onto the wall by attaching the housing 10 to the base-plate 11. This means that, in practice, if the dryer 1 is defective, the user can disconnect the hood 10 from the base-plate 11, and connect a defect-free replacement hood 10.

35 The electrical cut-off switch 501 means that there is an increased level of safety when the user opens up the hood 10, and either installs or removes the hood and its included assembly of components. The cut-off switch 501 ensures that the apparatus 1 cannot become electrically live until the hood is closed. A commercial benefit of this feature is that the dryer 1 can therefore be maintained by those who are not qualified electricians. Generally there may be cost savings on the maintenance of these drying apparatus, and there may also be substantial savings when the apparatus is used in countries where the
40 absence of live electricity in the opened-dryer would avoid the requirement of a qualified electrician to install the unit.

5 Also, in construction of large buildings, such as hotels or hospitals, it is possible for the baseplate to be installed initially by an electrician to connect the wiring to the mains power, and then for another person to later on attach the hood 10 with its attached components e.g. 400, 430.

Another advantage of the ability to separate the assembly of the hood 10 from the base plate 11 is that, rather than a repair technician having to repair the dryer 1 on location, the user can simply detach
10 the hood assembly 10, with its components, and replace it with a new hood. Then, the defective hood can be taken away for repair. This means the repairman need not spend excessive time at the location where the dryer is installed. Also, the user experiences less down-time, and the user may replace the hood with its components without assistance.

In the embodiment of Figure 1A and 1B, the dryer 1 is connected to an external source of
15 electricity by a terminal block 500. The terminal block facilitates connection of the electric control circuit of the dryer 1 to the external mains power supply.

In Figure 1B, the electrical control circuit of the dryer 1 has a plug 503 that is able to plug into the terminal block 500 in order to connect to the mains power source.

20 Sensors

In Figures 1A and 1B, the dryer 1 is provided with a sensor-means, in the form of a detector-sensor 600.

The detector-sensor 600 detects the presence of hands in the vicinity of the projecting end-opening 14 on the front of the hood 10. When hands are detected, the detector-sensor 600 activates the
25 rotating fan 401 and the heating element 300. Thus, when a user places his hands beneath the end-opening 14, the dryer 1 automatically activates and starts drying the user's hands.

In the embodiment, the detector-sensor 600 includes an infra-red sensor.

30 Sanitising The Ambient Atmosphere

By way of review, the dryer of Figure 1 has the capacity to remove bacteria particles from the air that is sucked into the housing 10, 11, and to expel it with all or substantially all of the bacteria particles removed. Thus, if the fan 401 were to be activated periodically, such a modified embodiments of
35 the dryer 1 can function as atmospheric bacteria-removal apparatus. For example, if the dryer 1 of the present embodiment were to be activated every 30 minutes, or hour, or some other appropriate interval, the air in the public toilet, for instance, can be regularly purified of a substantial portion of its airborne bacteria.

To achieve this, the modified apparatus 1 is provided with a timer-control-circuit to regularly
40 auto-activate the fan 401 for a predetermined period of time.

5 Thus, periodic automatic activation of the apparatus 1 effectively sterilises part of the ambient atmosphere surrounding the hand-drying apparatus. For example, the timer-control-circuit may activate for 3 minutes every half hour.

 In such a modified embodiment, the detector-sensor 600 can also detect the absence of hands. When the detector-sensor 600 detects that there is no presence of hands in the vicinity of the end-opening
10 14, it is able to auto-activate the dryer 1 to operate in the air-purifying mode with heating the air flow. This is to ensure that the dryer 1 does not blow cold or unwarmed air onto hands that are placed below the end-opening 14. Thus, the timer-control-circuit can activate the apparatus 1 at regular intervals or intermittently to sterilise the ambient atmosphere surrounding the apparatus 1.

 This feature that enables the hand dryer to have the added function of sterilising the ambient air
15 is useful particularly in seasons during the year when there are a greater occurrence of airborne diseases. For instance, it is particularly useful during influenza season.

 This feature also enables the dryer to act as an air-freshener, when a scented material is also held by the filter holder. For instance, a pad of fragrance or perfumed substance can be included between the filter holders 410A, 410C, 520A, 520C. When used in conjunction with the timer control circuit, it
20 means that the ambient air of a washroom or public toilet environment can be automatically and periodically infused at regular intervals with a fragrance.

 When using the apparatus 1 as a means of sanitising the ambient environment air and/or adding fragrance to the ambient air, it is preferred that the heating-element 300 not be activated, otherwise for example the temperature of the washroom could increase unnecessarily or to the point of discomfort for
25 the users.

 Alternatively, in some embodiments, the heating-element 300 is still activated during this automatic activation by the timer control circuit. It is found that having the heater operating during this automatic cycle does not excessively heat up the ambient air.

 Thus, some embodiments of the invention can function as a combined air-fragrancer, sterilised
30 hand dryer, and ambient air sanitiser.

 In a further embodiment, the timer-control-circuit is provided with light-sensor-means 504, and can optionally be constrained such that the timer-control-circuit only auto-activates the apparatus, for the purposes of ambient air sanitising and/or fragrancing, only when the light-sensor-means indicates that there is ambient light. In other words, this function will not auto-activate, for example, when the
35 washroom or toilet is in total darkness. This could apply to a case where a washroom is only used during the daytime, and there is no need for the apparatus to be operating continually through the night.

Further Alternatives

40 The embodiments have been advanced by way of example only, and modifications are possible within the scope of the invention as defined by the appended claims.

5 In other embodiments, the components of the fan casing 400 and the fan motor may be fastened to the base plate 11, rather than inside the hood 10.

In other embodiments, the air stream 200C can be emitted into a drying chamber, rather than directly to the ambient environment surrounding the dryer 1.

10 The shape of the post 502 and the cut-off mechanism can be varied to achieve the similar function. For instance, the cut-off mechanism could be incorporated at the hinge 12. The embodiment is not limited to a particular appearance of cut-off mechanism, as long as the cut-off occurs when the hood is opened up.

The number of filters can be varied, particularly depending on the power of the motor being used.

15 The style of motor or fan can be varied.

Any discussion of prior art in this specification is not to be taken as an admission of the state of common general knowledge of the skilled addressee.

The above specification contains description relating to a number of aspects of the present invention.

20 Other Industrial Applications

The filter arrangement of the present invention can also be used in other apparatus that draws in and expels an airflow, apart from warm air hand dryers. Such other apparatus include, but are not limited to: hair dryers, vacuum cleaners, fans, air conditioners, refrigerators, clothing tumble dryers.

25 In the following exemplary embodiments of a hair dryer, vacuum cleaner, fan and refrigerator, the above description of the characteristics and benefits, and preferred features of the filter arrangement of the hand dryer 1 are imported into the brief descriptions of the hair dryers, vacuum cleaners, fans, air conditioners, clothes dryer, refrigerator and other applicable applications:

30 Example: Hair Dryer

Figure 10A shows an embodiment of a filter arrangement used in a hair dryer 2.

35 The airflow through the hair dryer 2 is represented by an arrow 200A, 200C. Ambient air enters the hair dryer 2 (the arrow 200A), and is warmed, and then leaves the dryer (arrow 200C).

The intention, with the hair dryer 2, is the same as for the hand dryer 1, namely that the stream of hot air 200C emanating from the dryer should be free of bacteria.

40 The principles of arranging the filter arrangement in the hair dryer 2 are somewhat similar to that of the hand dryer 1 in terms of the sequence of filters in relation to the airflow, however, the sequence of attachment to the base element is reversed.

5 Figure 10A shows an exploded view of the main filter assembly 410A, 410B, 410C, 410D, 410E.

 Figure 10A shows the main filter assembly in relation to where it fits into the main entrance 405 of the casing 400 of the hair dryer. (Similar reference numerals are used as for earlier embodiments merely to assist the reader to understand the embodiment).

10 In Figure 10A, the filter assembly includes a base element 410A that fits directly into the main entrance or main aperture 405 of the hair dryer.

 The base element 410A is provided with several resilient claws 408 that enable the base element to engage and lock with the main aperture 405.

15 In the case of the hair dryer, the bacteria entrapment filter 410B does not connect directly with the base element 410A. Instead, the entrapment filter 410B must be the first in sequence to receive the incoming airflow 200A.

 The sequence of the filters is always described with respect to the direction of the airflow 200A, 200C.

20 Accordingly, a filter holder 410C is used to carry a bacteria entrapment filter material 410B. This is the first filter that the airflow 200A encounters as it enters the hair dryer 2. This entrapment filter 410B is coated with the anti-bacterial sticky coating, and performs as described above.

 Next, in sequence, the airflow encounters another filter holder 410E that is used to carry the charcoal-infused filter 410D. This charcoal filter 410D intercepts and removes from the airflow 200A any traces of the bacteria-killing material.

25 The filter holder 410E, for the charcoal filter, is the one that engages with the base element 410A.

 The base element 410A engages with the rear end of the hair dryer 2.

30 Thus, the airflow which enters the main entrance 405 of the hair dryer 2 is able to be 100% free of bacteria, and thus the warm airflow that is expelled onto the user's hair is also 100% bacteria free and, just as importantly, free of the toxic bacteria-killing substance.

35 In another embodiment in Figure 10B, a third filter can be added in sequence to add a substance-effusing filter, in similar manner as described above. A fragrance can be added to the airflow which can add a scent to the hair that is being dried. The fragrance filter would be positioned just between the base element 410A and the charcoal filter holder 410E. In other words, the fragrance filter would be the last filter in sequence.

 Figure 10C shows another modification of the embodiment of Figure 10A, having a four-filter arrangement similar to that shown in Figure 8C.

40 In other embodiments, the filter arrangement 410A to 410E can be housed inside the casing of the hair dryer 2 so as to be inconspicuous to the user. The internal stack of filters also has the bacteria-impermeable barrier, which confers benefits that have been described in relation to the internal construction of the hand dryer 1.

5

Example: Vacuum Cleaner

Figure 11A shows an embodiment of a filter arrangement used in a vacuum cleaner 3.

10 The airflow through the vacuum cleaner 3 is represented by an arrow 200A, 200C. Ambient air enters the vacuum cleaner 3 (the arrow 200A), is filtered for dust and large particulate, and then leaves the vacuum cleaner (arrow 200C). It still, however, contains bacteria, and hence the filter arrangement is used to remove the bacteria and germs.

Figure 11A shows an exploded view of the main filter assembly 410A, 410B, 410C, 410D, 410E.

15 Figure 11A shows the main filter assembly in relation to where it fits into the main outlet 405 of the rear of the casing 400 of the vacuum cleaner. (Similar reference numerals are used as for earlier embodiments merely to assist the reader to understand the embodiment).

In Figure 11A, the filter assembly includes a base element 410A that fits directly into the main entrance or main outlet-aperture 405 at the rear of the vacuum cleaner.

20 The base element 410A is provided with several resilient claws 408 that enable the base element to engage and lock with the main outlet-aperture 405.

In the case of the vacuum cleaner, once again, the entrapment filter 410B is the first in sequence to contact the outgoing airflow 200C.

25 The sequence of the filters is always described with respect to the direction of the airflow 200A, 200C.

In Figure 11A, the filter assembly includes a base element 410A that fits directly into the main entrance or main outlet-aperture 405 at the rear of the vacuum cleaner. The base element 410A is provided with several resilient claws 408 that enable the base element to engage and lock with the main outlet-aperture 405.

30 The airflow 200C, emanating from the vacuum cleaner, first encounters a bacteria entrapment filter 410B. The bacteria entrapment filter 410B is supported and housed by a filter holder 410C which engages with the base element 410. This entrapment filter 410B is coated with the anti-bacterial sticky coating, and performs as described above.

35 The base element 410A and the filter holder 410C are provided with corresponding bayonet mounting parts, to enable these parts to fit with a bayonet-style engagement. In other embodiments, other forms of engagements mechanisms can be used, such as inter-fitting pins or press fit mounting.

Next, in sequence, the airflow encounters the charcoal-infused filter 410D which is carried or housed by another filter holder 410E. This charcoal filter 410D intercepts and removes from the airflow 200A any traces of the bacteria-killing material.

5 Thus, the airflow leaving the main outlet 405 of the vacuum cleaner 3 is able to be 100% free of bacteria and, just as importantly, free of the toxic bacteria-killing substance. Thus it does not contribute to the bacterial contamination of the ambient atmosphere.

 In other embodiments, the filter arrangement 410A to 410E can be housed inside the casing of the vacuum cleaner 3 so as to be inconspicuous to the user. The internal stack of filters also has the
10 bacteria-impermeable barrier, which confers benefits that have been described in relation to the internal construction of the hand dryer 1.

 The air that comes out of ordinary vacuum cleaner contain germs that are sucked off the floor. Hence, the above filter arrangement helps to remove the bacteria from the emanating airflow from the vacuum cleaner.

15 Figure 11B shows another modification of the embodiment of Figure 11A, having a four-filter arrangement similar to that shown in Figure 8C.

Example: Fan

20 Figure 12A shows a front view of a fan 4 that uses an embodiment of a filter arrangement. Figure 12B shows a side view of the fan.

 The airflow through the fan 4 is represented by arrows 200A, 200C.

 The rotatable fan blades 4A are housed in an enclosure comprised of a cage made up of two opposed and facing half-dome-like cages 4B-F, 4B-R (F=front, R=rear).

25 Ambient air (arrow 200A) enters the rear of the fan 4 through the rear half-dome cage 4B-R, and is expelled by the fan through the front half-dome cage 4B-F (arrow 200C).

 Figure 12C shows an exploded side view of the main filter assembly 410A, 410B, 410C, 410D, 410E, 410F, 410G. (Similar reference numerals are used as for earlier embodiments merely to assist the reader to understand the embodiment).

30 Attached to the outer surface of the rear dome-like cage 4B-R is a filter arrangement which is formed as a stack of nested half-dome-like filter holders 410C, 410E, 410G. Each of these filter holders carries within its dome a fibrous filter of the like described above in relation to the filters used in the hand dryer 1.

 In the embodiment, the function of the filter arrangement is the cause the airflow 200C,
35 emanating from the fan, to contain substantially less bacteria than the airflow 200A which enters the fan.

 Figure 12B shows a side view of the main filter assembly with all the filter holders 410C, 410E, 410G attached to each other in sequence. The filter holders 410C, 410E, 410G are more clearly seen in the exploded view of Figure 12C.

 The filter holders are provided with attachment means that enables them to be attached to the
40 back of the rear dome-like cage 4B-R. The actual attachment means is not illustrated here, and can be implemented in numerous forms.

5 As the airflow 200A is drawn towards the fan 4, it initially encounters a first filter holder 410C which contains, held on its inner curved surface, a bacteria entrapment filter material 410B, of the kind and function described above in relation to the hand dryer 1.

Next, where applicable or required, the airflow 200A encounters a second filter holder 410E which contains, held on its inner curved surface, a charcoal-particle infused filter 410D, of the kind and
10 function described above in relation to the hand dryer 1.

Preferably, the airflow 200A encounters a third filter holder 410F which contains, held on its inner curved surface, an effusing filter 410F which effuses an emittable-substance, from the fibres of the filter 410F, into the airflow, of the kind and function described above in relation to the hand dryer 1.

Thus, the airflow which enters the expelled from the fan is able to have substantially less
15 bacteria than the level of the ambient air, and, just as importantly, is free of the toxic bacteria-killing substance that is used to kill the bacteria in the entrapment filter 410B.

In other embodiments, the filter arrangement 410A to 410G can be housed inside a casing for the fan 4 so as to be inconspicuous to the user.

The filter holders 410C, 410E, 410G are formed as semi-circular dome-like cages that have a
20 slit along a radius of the dome that can be spread apart temporarily to enable the filter holders to fit over the supporting stand or frame 4C of the fan.

The filter holders each also have a centrally located hole to accommodate the frame 4C of the frame.

In the embodiment, the actual configuration of the fan is not part of the invention, since
25 embodiments of the filter arrangements, of the present invention, can be adapted for use with a wide variety of fans.

Figures 12D and 12E show a further embodiment of a filter arrangement used with a fan, having a four-filter arrangement that has a similar function to that of the embodiment in Figure 8C.

30 Examples: Air Conditioner & Garment Dryers

Embodiments of the filter arrangement can also be incorporated in air conditioners and garment or clothes dryers. In the case of garment dryers, the filter arrangement is on the air inlet to ensure that the clothes are not subjected to bacteria-laden air

35 In the case of hair dryers and garment dryers, the filtering occurs as the airflow enters the device.

In the case of the hand dryer and vacuum cleaner, the filtering occurs as the air flow leaves the device.

Embodiments of the filter arrangement can also incorporated in refrigerators to ensure that the
40 air that enters the interior of the refrigerator is free of bacteria.

Three and four filter arrangements can also be used in these embodiments.

5

Examples: Clothes Dryer

Figure 13 shows a simple schematic diagram of a clothes dryer 5. The actual mechanics of the machine are known to a skilled address in the field of clothes dryers, and are not described in detail here.

10 The clothes dryer 5 contains an enclosure 5A within the machine that receives hot air to dry the clothes.

An airflow 200A enters the machine, and passes first through a bacteria entrapment filter 410B, of the kind and function described above in relation to the hand dryer 1.

15 Next, in sequence, the airflow 200A passes through a charcoal-particle infused filter 410D, of the kind and function described above in relation to the hand dryer 1.

Thus, the airflow which enters the enclosure 5A is able to have substantially less bacteria than the level of the ambient air, and, just as importantly, is free of the toxic bacteria-killing substance that is used to kill the bacteria in the entrapment filter 410B.

20 Three and four filter arrangements can also be used in these embodiments used in clothes dryers.

Examples: Refrigerator

25 Figure 14 shows a simple schematic diagram of a refrigerator 6. The actual mechanics of the refrigerator are known to a skilled address in the field of refrigeration manufacture, and are not described in detail here.

The refrigerator 6 contains an enclosure 6A which receives chilled refrigerated air.

An airflow 200A enters the machine, and passes first through a bacteria entrapment filter 410B, of the kind and function described above in relation to the hand dryer 1.

30 Next, in sequence, the airflow 200A passes through a charcoal-particle infused filter 410D, of the kind and function described above in relation to the hand dryer 1.

Thus, the airflow which enters the enclosure 6A is able to have substantially less bacteria than the level of the ambient air, and, just as importantly, is free of the toxic bacteria-killing substance that is used to kill the bacteria in the entrapment filter 410B.

35 Three and four filter arrangements can also be used in these embodiments used in refrigerators.

Chemical Release Agent

40 In the embodiment of the hand dryer 1 and other embodiments of airflow apparatus described above, the airflow is able to be intermittent. In other words, there can be lengthy periods of time where there is no operational airflow generated through the apparatus.

5 Reference is made to the exemplary embodiments of Figures 8A and 8C, and also Figures 10B, 10C, 11B, 12C, 12D, and the like. In these embodiments, where there are one or more effusing filters 410F, 410FF, there is an active substance on the filter fibres that is capable of becoming airborne. For instance, in the embodiments, the active substance could be a fragrance, perfume, or even a mild non-toxic anti-bacteria substance.

10 In the air-flow activated composition, the active substance, is capable of becoming airborne at least for a useful period of time. For instance, the active substance can evaporate into a vapour, or effuse into the air as a mist.

 In a modified embodiment, the active substance is able to be combined with a release agent that restrains the active substance from becoming airborne at normal room temperature and pressure, however, 15 upon exposure of the composition to the airflow, the release agent will release the active ingredient into the air stream.

 An advantage of using the active substance, in combination with such a release agent, is that it avoids or minimises passive effusion of the active substance into the atmosphere when there is no airflow operating through the apparatus. Thus, the active substance, found on the filter, can potentially last 20 longer, compared to a case where the active substance were to be continually and gradually effusing into the air, even when there is no operational airflow.

 The active substance may be any substance or combination of substances that may usefully be made airborne for the purposes of the invention. For example, the active substance may be a fragrance, deodorant or biocide. The biocide may be a bactericide or insecticide. Preferably, the active agent is a 25 biocide such as n-alkyl dimethyl benzyl ammonium saccharinate, quaternary ammonium salts (such as chlorides), Triclosan, o-benzyl chlorophenol, 2-phenylphenol and/or N-alkyl N-Ethyl morpholinium sulphates.

 Preferably, the active substance is volatile within the normal range of ambient temperatures and pressures, but this is not essential to the invention as long as the active substance is able to remain 30 airborne for sufficient time to have its useful effect.

 The active substance may be dissolved or suspended in a carrier. The carrier may be formulated to enhance the volatisation of the active substance, once released into the surrounds. The carrier may be formulated to physically and/or chemically stabilise the active substance against deterioration over time. For example, the carrier may include a UV stabiliser to reduce deterioration of the active substance where 35 the active substance may be exposed to sunlight during transport or storage.

 The carrier may be a solvent that is volatile at room temperature, preferably non-toxic to mammals, such as water, linseed oil, suitable organic solvents, alcohol or a mixture thereof. Solvent mixtures may be advantageously used, for example, where the active substance comprises two or substances having different solubilisation or dissolution properties. Preferably, where the active substance 40 and/or the carrier include a volatile component, the release agent will encapsulate the active substance and/or the carrier.

5 The release agent includes any substance or combination of substances that:

(1) is/are adapted to contain or retard the active substance against becoming airborne such as by volatisation; and

(2) remain stable at normal room temperature and pressure in still air.

The release agent will therefore vary in formulation and/or preparation according to the
10 properties of the active substance used in a particular application. The release agent will therefore be compatible with the active substance and different formulations of release agent will be applicable depending on the active substance. The active substance may be impregnated, embedded or encapsulated in, or physically or chemically bonded to the active substance. In a particularly preferred formulation according to the invention, the active agent includes a volatile biocide microencapsulated in the release
15 agent. In another preferred form, the active substance is a fragrance.

The release agent may be a solvent, gel, paste or slurry with low or virtually no volatility at room temperature and pressure, the solvent, paste or gel able to be volatised only by the application of air flow and/or warmed air. For example, the active substance may be stably impregnated, dissolved or mixed in the release agent at room temperature and pressure, the active substance at least substantially
20 retarded against volatisation and preferably trapped in the release agent. Upon exposure to flowing air, optionally heated, the release agent may become volatile and/or unstable to release the active substance to the passing air stream.

Where the release agent includes a solvent, this may be viscous and non-volatile at room temperature and pressure. Examples of suitable solvents include vegetable oils with suitably heavy
25 fractions such as cooking oils, lanolin, and fatty acids such as stearic acid.

Where the release agent includes a gel, this may be a polymeric material. The polymeric material may be a homopolymer or copolymer. The polymeric material may be cross linked.

Preferably, the release agent is in the form of small capsules or microcapsules. The microcapsules typically have a diameter smaller than 500 μ m, and preferably are in the range 5 - 200 μ m.
30 A particularly preferred type of capsule is a wall or shell type capsule which has a generally spherical, hollow shell of material insoluble to the active substance. The material is normally a plastic material. The plastic material may be a polymer or copolymer, optionally crosslinked and optionally including suitable additives known in the art to achieve desired properties. The plastic material may be a resin. The plastic material may be an amino resin such as the condensation products of urea and of melamine with
35 formaldehyde.

There are various methods of making such shell capsules including *in situ* polycondensation used to produce aminoplast resin capsules from urea-formaldehyde or melamine- formaldehyde polymers. The process may involve forming a dispersion or emulsion of the active substance, for example in an aqueous solution of urea-formaldehyde or melamine-formaldehyde precondensate under agitative
40 conditions to obtain capsules in a preselected size range. Conditions can be adjusted to cause

5 condensation of the precondensate by acid catalysis resulting in the condensate separating from solution and surrounding the dispersed active substance to produce microcapsules.

The microcapsules show excellent active substance retention over long periods because the capsule prevents evaporation or other loss of the active substance until the integrity of the capsule walls is disrupted to release active substance or the walls are otherwise ruptured. In its most preferred form, the present invention is concerned with microcapsules having good storage stability properties in static air, but having polymer walls adapted to lose sufficient structural integrity on exposure to rapidly flowing air.

The microencapsules are optionally formed by a coacervation process in which a carrier in the form of an oil reservoir is surrounded by a very thin polymeric membrane which is generally mechanically very unstable, but hydrophobic and resistant to humid conditions such as may be found in a public rest room. This property is exploited in use in the active substance delivery application, wherein the delivery is initiated by mechanical force, such as by the application of a stream of air to disturb the integrity of the polymeric membrane and to release the active substance.

Where the release agent includes a paste or slurry, this may include a synthetic or natural adhesive such as gum Arabic or a synthetic polymer adhesive to act as a binding agent.

20 The release agent may be a micro porous encapsulation product. The release agent may be a melamine polymer shell. The melamine polymer shell is preferably comprised of microencapsulates adapted to retain the active agent. The polymer shell may be impervious and therefore effective to contain a volatile active agent, such as a fragrance or biocide. The microencapsulates may contain both fragrances and biocides. The fragrances may be chemically unreactive and therefore storable in the same microcapsule without deterioration. Alternatively some of the microencapsulates may contain fragrance, and others, biocide. The mixture of microencapsulates may be stored in the same device, such as a filter cartridge. The microcapsules may vary dimensionally, such as in the range 3 - 500µm, preferably 3 - 200µm and still more preferably 5-100µm.

The release agent may be suitably formulated for bonding or otherwise adhering to a substrate. The substrate may be a porous panel such as wire or plastic mesh. The panel may be of sufficient gauge to permit the flow of air there through. The release agent may be sufficiently tacky or sticky to adhere to the surface of the panel and to itself.

The substrate may be a filter medium. The filter medium may be filter fibres. The filter media may be natural or synthetic material, depending on the application and the filtration properties required. The filter media may include cellulosic based fibre, such as cotton weave, or a synthetic material, such as polyester, or a combination thereof. The substrate may be additionally impregnated or coated with other useful substances such as carbon to act as a deodoriser and/or absorbent.

The release agent and active substance may together be applied as a mass, optionally layered, to the substrate by spraying, brushing or rolling on. As air flow is applied to the substrate, the surface layer of the composition is depleted, thereby exposing previously unexposed surface to the surrounding

5 environment. The composition mass may advantageously present new surface material through multiple applications of flowing air over time.

Preferably, the active substance is contained in the release agent in the form of polymer microcapsules. The microencapsulates may be sprayed or otherwise applied onto the substrate surface, such as a filter, for installation in a cartridge. The microcapsules may be applied by spraying an emulsion
10 onto the substrate. A suitable microencapsulate system may be obtained from Reed Pacific Pty Ltd under the product name "Potenza", optionally with suitable additives to provide the air-flow release capability.

The composition may be presented in the form of an enclosed cartridge for the preservation of the composition and easily substitution for spent, like components. The cartridge may include a sealed container in which is housed the composition for storage. The cartridge is preferably vacuum sealed once
15 the composition is delivered to the cartridge. The cartridge may be made from any suitable material resistant to the composition components. Suitable materials may include APET, PETG, polypropylene and polyacrylonitrile for their clarity, thermoformability and general chemical resistance. Other materials having less clarity may include polyethylene, and nylon. Other materials may be selected for their strength and chemical resistance, such as aluminium or stainless steel. Of course, the skilled person will
20 select a suitable material or combination of materials according to the composition formulation.

The container may include a seal. The seal may be activated to expose the contents of the cartridge to the surrounding environment. The seal may be deflectable, removable or penetrable. The seal may be adapted to be activated when the cartridge is placed in active use to expose its contents. The seal may be a membrane or film. The membrane or film may be made from metal foil or soft plastic such as
25 polyethylene.

The composition may be applied to the substrate in the form of panels arranged in parallel or in series, depending on the application, with respect to the anticipated direction of air flow in use. Alternatively, the substrate may be in the form of columns, nodules or amorphous fibre, whereby new surface of the composition is exposed to the surrounding air as the previous composition surface is
30 progressively depleted.

Normal room temperature, humidity and pressure will vary depending on a number of factors including location and season. Generally, high altitude locations far from the equator will be characterised by cooler temperatures and lower air pressures, whereas equatorial regions will be characterised by warmer ambient temperatures and higher humidity and pressure. The skilled person will appreciate that
35 such factors need to be considered in determining the composition formulation.

EXAMPLE 1

A lemon-scented fragrance was encapsulated in micro melamine polymer shells ranging
40 between 5-100µm in size. The polymer shells were impervious to the encapsulated fragrance to preserve the fragrance until the release trigger was activated. (However, the polymer shells are sufficiently thin

5 whereby their structural integrity is easily disrupted by mechanical agitation; such as by the application of a blast of moving air over the surface of the polymer shells.) The microencapsulates were sprayed onto a filter cartridge and the cartridge was vacuum sealed. The cartridge was then opened and installed in a washroom hand dryer. When the hand dryer was on, a passage of warm air (about 50°C) passed through the cartridge. The flow of air structurally disrupted the microencapsulates polymer shell walls and volatile
10 fragrance was released. The cartridge was left in the hand dryer and anecdotally tested for fragrance effectiveness many times per day. A good spread of fragrance release was observed over a thirty five day period. Suitable encapsulate product may be purchased from Canpoint International Pty Limited of Lidcombe, NSW, Australia. Independent testing by a UK laboratory showed that the application of the composition to the filter medium resulted in at least a 79% reduction in the total number of live airborne
15 fungal spores in air having passed through the air dryer containing an active cartridge.

EXAMPLE 2

A suitable composition formulation in the form of a stable perfumed gel is described in US
20 Patent No. 5,419,879 to Vlahakis et al. US 5,419,879 describes the manufacture of a perfumed stable gel comprised of a combination of chemical components. The perfumed stable gel has a melting point temperature range of from about 125 DEG F. to about 150 DEG F. The preferred melting point temperature of the gel is about 140 DEG F. The perfumed stable gel has a perfume content of from about 70.0% to about 85.0% by weight of the composition. The preferred perfume content is about 75.0% to
25 about 80.0% by weight of the composition. The more preferred perfume content is about 75.0% by weight of the composition. The stable nature of the perfumed gel of this prior art disclosure means that the gel can be maintained as a solid, homogeneous, uniform mixture. The perfumed stable gel will not liquefy or form a slurry, but will remain as a solid, under the above temperature conditions and having the above perfume content.

30 Vlahakis' perfumed stable gel composition includes water in an amount of from about 2.0% to about 10.0% by weight of the composition. Preferably, the water is at its boiling point when initially mixed with an odourless glycol, and preferably the water is in an amount of about 5.0% by weight of the composition.

The perfumed stable gel composition also includes a soap in an amount of from about 5.0% to
35 about 15.0% by weight of the composition. The preferred soap is sodium stearate having a carbon content in the range of C12 -C20 and having a melting point of about 158 DEG F. or higher. Preferably, the soap is in an amount of about 7.5% by weight of the composition in the formulations for the cherry, jasmine, baby powder, and spice deodorant gels. Preferably, the soap is in an amount of about 9.0% by weight of the composition in the formulations for the green apple, lemon, bubble gum, spearmint, and gardenia
40 deodorant gels. The increased amount of soap in these latter formulations increases the melting point and aids in solubilizing the perfumes.

5 Vlahakis' perfumed stable gel composition also includes a non-ionic surfactant to increase the melting point of the composition and aid in initially maintaining the composition product in solution and later stabilizing the composition product as a solid. Preferably, the non-ionic surfactant contains a sufficient amount of ethylene oxide to provide a melting point temperature in the range of from about 100 DEG F. to about 150 DEG F. The non-ionic surfactant is preferably in an amount of from about 2.0% to
10 about 15.0% by weight of the composition. More preferably, the non-ionic surfactant is in an amount of about 3.75% by weight of the composition. The preferred non-ionic surfactants that are used include nonylphenols, polyethylene glycols, or a mixture thereof. The nonylphenols may include Nonoxynol 100, with 100 mols of ethylene oxide in the product, Iconol NP-100, and nonylphenols of 80 mols up to 150 mols. The polyethylene glycols may include polyethylene glycol 8000 and BASF's Pluracol line. Other
15 non-ionic surfactants that can be used include non-ionics similar to BASF's Tetronic and Tetronic R line. However, this latter group of non-ionic surfactants is generally more expensive to use than the former groups.

The perfumed stable gel composition also includes a preservative in an amount of from about 0.1% to about 0.3% by weight of the composition. The preservative helps to inhibit the growth of mould
20 or fungus on the surface of the perfumed stable gel. The preferred preservative used in the present invention is Glydant (chemically known as DMDM Hydantoin (55% solution)(C7 H12 N2 O4)-- Chemical Abstract No. is 6440-58-0). Preferably, the preservative is in an amount of about 0.25% by weight of the composition.

Vlahakis' perfumed stable gel composition may also include a perfume component. It has been
25 found that an effective perfume content for Vlahakis' composition is in an amount of from about 70.0% to about 85.0% by weight of the composition. For the purposes of the present invention, it is preferred that the amount of perfume be reduced to less than about 50% by weight of the composition to afford greater stability with the other components increased proportionally to make up the balance of the percentage weight of the composition. The perfume agent enhances the odour characteristics of the
30 product. Specific examples of suitable perfume agents include lemon, bubble gum, cherry, spearmint, green apple, baby powder, gardenia, jasmine, herbal, spice, and others. The primary scents used are obtained from the fruity and floral scent groups. However, it is possible to produce any number of different scents depending on the type of scent desired.

Vlahakis' perfumed stable gel composition also includes an odourless glycol. The amount of
35 odourless glycol used in the chemical composition should be sufficient to aid in solubilizing the perfume component. The addition of an odourless glycol aids in the stability of the evaporation rate of the composition and aids in increasing the melting point of the composition. Preferably, the amount of odourless glycol used is in an amount of from about 0.1% to about 12.0% by weight of the composition. The preferred amount of odourless glycol is about 8.75% by weight of the composition. The preferred
40 odourless glycols used in the composition include propylene glycol, glycerol, hexylene glycol, or a mixture of two or more thereof.

5 Vlahakis' perfumed stable gel composition may also include inert filler materials. The amount of filler material used in the composition is from 0% to about 4.0% by weight of the composition. Preferably, the amount of filler material used is about 0.5% by weight of the composition. The filler material may be selected from the group including diatomaceous earth, clay, dirt, silica and sand. The addition of these filler materials to the composition is optional. However, the filler material helps to
10 control the evaporation rate of the perfume component.

Vlahakis' perfumed stable gel composition may also include ethanol or odourless mineral spirits. The amount of ethanol or odourless mineral spirits used is from 0% to about 5.0% by weight of the composition. Preferably, the amount of ethanol or odourless mineral spirits used is about 3.0% by weight of the composition. The ethanol and odourless mineral spirits aid in solubilizing some of the
15 perfumes and in lowering the costs of manufacturing some of the more expensive perfumes (i.e., green apple) without affecting the performance of the gels. Preferably, the mineral spirits are comprised of aliphatic hydrocarbons.

The manufacture of Vlahakis' perfumed stable gel involves the mixing of: (1) an oil phase and (2) a water phase. The oil phase includes the non-ionic surfactant and the desired perfume. First, the non-
20 ionic surfactant is heated to a temperature in the range of from about 120 DEG F. to about 150 DEG F. It is heated in a 55 gallon jacketed stainless steel mixing vessel. Heating bands surrounding the mixing vessel act to heat and liquefy the non-ionic surfactant. The non-ionic surfactant is heated in this manner for about 24 to 48 hours, depending on the size of the batch and the heating temperatures used.

After the non-ionic surfactant has been sufficiently heated and liquefied, it is transferred to a
25 smaller open-top 55 gallon jacketed stainless steel mixing vessel. This mixing vessel also has heating bands surrounding it which act to heat the non-ionic surfactant and the perfume, which is added at this step in a pre-measured amount. The two components are thoroughly mixed in the mixing vessel with an electric mixer that has an attached agitator working at approximately 750 rpm. The perfume is mixed with the non-ionic surfactant for approximately 10 minutes at a temperature in the range of about 120 DEG F.
30 to about 150 DEG F.

The second phase involved in forming the perfumed stable gel is the water phase. To manufacture the water phase, a pre-measured amount of the odourless glycol is added to boiling hot water. The glycol and water are mixed together in an open-top 55 gallon jacketed stainless steel mixing vessel. The two components are thoroughly mixed in the mixing vessel with an electric mixer that has an
35 attached agitator working at approximately 750 rpm. The odourless glycol is mixed into the hot water for approximately 5 minutes at a temperature of about 158 DEG F. Next, the soap is added in a pre-measured amount to the glycol/water mixture. The soap is thoroughly mixed into the glycol/water mixture in the mixing vessel until the soap is dissolved and there are no clumps remaining. The soap is mixed with the odourless glycol and water for approximately 15 minutes to 30 minutes at a temperature of about 158
40 DEG F.

5 Next, the mixture of the water, the odourless glycol, and soap, i.e., the water phase, is added to the non-ionic surfactant and perfume, i.e., the oil phase. All of these components are thoroughly blended at a temperature of over 140 DEG F. in the mixing vessel with an electric mixer that has an attached agitator working at approximately 750 rpm. The preservative is added at this stage of the mixing. All of these components are then thoroughly mixed for approximately 15 minutes.

10 Finally, an optional filler material can be added to the mixture by spooning with a ladle a desired amount of the filler material into the mixture. The mixture is stirred thoroughly until the desired consistency is reached.

 Once it is determined that the composition is thoroughly blended and while it is still in the molten state, the composition is spooned with a ladle out of the mixing vessel and into the individual
15 deodorant containers.

 Lastly, the containers holding the composition are cooled by placing the dispensers on a conveyer belt and blowing cold air upon those dispensers. The cold air is passed through a tunnel fed by an air conditioning unit. During the containers' 3 to 5 minutes in the tunnel, the gel composition solidifies in the dispenser assembly, thus securing the completed perfumed stable gel in the disposable deodorant
20 container. The amount of composition prepared at one time is limited to the amount that is to be filled in the dispensers on a particular day. Typically, this amount can vary between 200 pounds to 400 pounds per day.

EXAMPLE 3

25 In prior art GB Patent Application No. 1,432,163 (CIBA GEIGY AG) there is described a slow release formulation which is suitable for use in the present invention, release of active substance being negligible in still air at room temperature and pressure, but accelerated when subject to an air stream at elevated temperature, such as may be provided in or adjacent an electric fan hand dryer.

30 Particularly good long lasting deodorising is obtained using the following air conditioning preparations according to the formulation in GB 1,432,163:

1) Gelling agent: bentonite derivatives or aluminium soaps

Deodorant: dimethylfumarate or diethylfumarate; and

Reodorant: diphenylmethane, diphenylether, bornylacetate or mixtures thereof, wherein with
35 bornylacetate and linalool deodorising action is still evident, even after 90 days.

2) Gelling agent: polymer resins

Deodorant: dimethylfumarate or diethylfumarate;

Reodorant: diphenylether, bornylacetate.

3) Gelling agent: bentonite derivatives, aluminium soaps or polymer resins

5 Deodorant: citral or several aldehydes which are free of aromatic nuclei;
Reodorant: diphenylmethane, wherein using bentonite derivatives as gelling agents, deodorising action is still evident even after 90 days.

4) Gelling agent: bentonite derivates

Deodorant: phenylacetaldehyde and similar aldehydes containing at least one aromatic nucleus;

10 Reodorant: diphenylmethane, diphenylether, bornylacetate, wherein deodorising action is still evident even after using the preparation for 90 days.

5) Gelling agent: aluminium distearate

Deodorant: mixture of citral and dimethyl and/or diethyl fumarate in a weight ratio of 1:5 to 5:1;

15 Reodorant: diphenylether or bornylacetate, wherein deodorising is still evident even after use of this preparation for 90 days.

The composition is preferably prepared by:

1) heating the total quantity of gelling agent such as aluminium soap and liquid paraffin regularly and with continuous stirring until one obtains a homogenous gelled mass of temperature between 70 and 150 °C;

20 2) cooling the resultant gel with continued stirring to 90 °C; adding the total quantity of deodorant and reodorant;

3) adding the total quantity of deodorant and reodorant; and finally

4) casting the resulting fluid gel into moulds at about 80 °C or working it to a granulate in a granulation apparatus.

25 On cooling the preparations according to this prior art composition example, there is obtained a solid preparation. This preparation can easily be removed from moulds and can then be packed in a casing such as a modular cartridge installable in a blower hand dryer, the cartridge being impermeable for the deodorant and reodorant components in storage, this cartridge being opened or activated by the user to expose the composition.

30 The embodiments have been advanced by way of example only, and modifications are possible within the scope of the invention as defined by the appended claims.

CLAIMS:

1. A sterilising hand-drying apparatus adapted to produce a stream of substantially sterilised, heated air for drying hands, the apparatus including:
 - a housing;
 - heating-means positioned in the housing for heating of air useable for drying hands;
 - inlet-means through which the air, in use, enters the housing and travels to reach the heating-means;
 - outlet-means through which the air, in use, after being heated by the heating-means, is emitted as heated air useable for drying hands; and
 - airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-means via the heating-means to the outlet-means;
 - wherein the apparatus is provided with bacteria-entrapment-filter-means through which, in use, the airflow passes, and
 - wherein the bacteria-entrapment-filter-means, in use, is adapted to trap and retain therein a substantial portion of bacteria in the airflow, such that the airflow leaving the bacteria-entrapment-filter-means is more sterile than when entering the bacteria-entrapment-filter-means,
 - the entrapment filter-means being in the form of a fibrous matrix that has on its fibres a toxic bacteria-killing substance which is able to kill any bacteria that impinges on the bacteria-killing substance on the fibres.
2. Apparatus of claim 1 wherein the bacteria-killing substance is a liquid-applied substance which, when on the fibre, presents a sticky coating on the fibre which captures bacteria that impinges on the bacteria-killing substance found on the fibres.
3. Apparatus of claim 1 or 2 wherein the airflow leaving the bacteria-entrapment-filter-means has numerically fewer bacteria than the airflow entering the bacteria-entrapment-filter-means.
4. Apparatus of any one of the preceding claims wherein the airflow leaving the bacteria-entrapment-filter-means is fully or at least substantially bacteria-free.
5. Apparatus of any one of the preceding claims wherein the airflow leaving the bacteria-entrapment-filter-means is 100% free of bacteria particles.
6. Apparatus of any one of the preceding claims wherein the bacteria-entrapment-filter-means intercepts the airflow before the airflow reaches the heating-means.

7. Apparatus of any one of the preceding claims wherein the inlet-means includes at least one main entrance through which all the airflow that is emitted from the hand-drying apparatus has to pass initially through this main entrance
8. Apparatus of claim 7 wherein the at least one main entrances is located totally inside the housing.
9. Apparatus of claim 8 wherein the at least one main entrance is located in an entrance into the airflow-generation-means such that all air entering the airflow-generation-means passes through this at least one main entrance.
10. Apparatus of claim 9 wherein the airflow-generation-means is contained in a casing and wherein said at least one main entrance is located on the casing.
11. Apparatus of claim 7 wherein the at least one main entrance is located on the housing of the apparatus, and wherein all other entrances into the housing, apart from said at least one main entrance, are sealed so that, in operational use, air can only enter the housing through said at least one main entrance.
12. Apparatus of any one of claims 7 to 11 wherein the inlet-means includes one or more secondary entrances arranged in series with the main entrance through which the airflow passes sequentially one after another.
13. Apparatus of claim 12 wherein the main entrance is separated from its next nearest entrance in the series by a substantial space that contains sufficient air to satisfy the air intake requirements of the airflow-generation-means in terms of volume of air per unit time.
14. Apparatus of claim 12 or 13 wherein at least one of the secondary entrances is located on an external surface of the housing, and accessible by the user from outside of the housing.
15. Apparatus of any one of claims 12 to 14 wherein each of said secondary entrances is provided with said bacteria-entrapment-filter-means.
16. Apparatus of any one of claims 7 to 15 wherein the main entrance is provided with said bacteria-entrapment-filter-means.

17. Apparatus of any one of the preceding claims wherein said bacteria-entrapment-filter-means includes a fibrous, dense filter material that is sufficiently dense to intercept and entrap a substantial portion of bacteria particles in the airflow.
18. Apparatus of claim 17 wherein the filter material is a non-woven fibre.
19. Apparatus of claim 17 wherein the filter material has average gaps or pores between the fibres selected to be around 150 microns.
20. Apparatus of claim 17 wherein the filter material has an air permeability of around 234.7 cm³/cm²/sec.
21. Apparatus of any one of the preceding claims wherein the bacteria-entrapment-filter-means includes a filter-replacement mechanism that is able to automatically replace the filter material in use with replacement filter material.
22. Apparatus of claim 21 wherein the filter-replacement mechanism replaces the filter material in use with replacement filter material periodically after a period of time.
23. Apparatus of claim 21 wherein the filter-replacement mechanism replaces the filter material in use with replacement filter material progressively in a continuous or intermittent manner.
24. Apparatus of claim 21 wherein the filter material is in the form of a sheet-like strip.
25. Apparatus of claim 24 wherein the filter material is conveyed by a motorised reel-mechanism.
26. Apparatus of any one of the preceding claims:
wherein the apparatus is provided with an electric control circuit that supplies electrical power to the apparatus,
and wherein the electric control circuit is provided with a cut-off mechanism that disables the supply of electrical power when the housing is opened so as to minimise risk of the user being electrocuted when opening the housing.
27. Apparatus of claim 26 wherein the cut-off mechanism includes a two-state switch which enables the supply of electrical power only when in the first state, and wherein an actuator is provided within the housing that maintains the switch in the first state when the housing is closed, and which activates the

switch into the second state when the housing is opened to thereby disable the supply of electrical power to the apparatus when the housing is opened.

28. Apparatus of claim 26 wherein the cut-off mechanism includes a resiliently-mounted switch which enables the supply of electrical power only when depressed, and wherein a cut-off-mechanism-activator is provided within the housing and arranged so as to depresses the switch when the housing is closed, and to lift off the switch when the housing is opened thereby to disable the supply of electrical power to the apparatus when the housing is opened.

29. Apparatus of claim 28 wherein the resiliently-mounted switch is mounted on a base-mounting to which a hood of the housing is removably attachable, and the cut-off-mechanism-activator is mounted on an interior surface of the hood.

30. Apparatus of claim 28 wherein the cut-off-mechanism-activator is mounted on a base-mounting to which a hood of the housing is removably attachable, and the resiliently-mounted switch is mounted on an interior surface of the hood.

31. Apparatus of claim 29 or 30 wherein the cut-off-mechanism-activator is in the form of a depressor that activates the cut-off mechanism when in contact therewith.

32. Apparatus of claim 29 or 30 wherein the base-mounting is adapted to be fastened to an upright mounting surface, such that the hand-drying apparatus is able to be installed onto the upright mounting surface by attaching the housing to the base-mounting.

33. Apparatus of any one of the preceding claims wherein the hand-drying apparatus is provided with a timer-control-circuit to regularly auto-activate the airflow-generation-means for a predetermined period of time so that the hand-drying apparatus effectively sterilises part of the ambient atmosphere surrounding the hand-drying apparatus.

34. Apparatus of claim 33 wherein the timer-control-circuit auto-activates the apparatus without concurrently activating the heating-means.

35. Apparatus of claim 33 wherein the timer-control-circuit auto-activates the apparatus while concurrently activating the heating-means.

36. Apparatus of any one of claims 33 to 35 wherein the timer-control-circuit is provided with light-sensor-means and only auto-activates the apparatus only the light-sensor indicates that there is ambient light.

37. Apparatus of any one of claims 33 to 36 wherein the apparatus is provided with hand-sensor-means which detects the presence of hands in the vicinity of the outlet-means and is adapted to activate the airflow-generation-means and the heating-means when hands are so detected, and wherein the timer-control-circuit only auto-activates the apparatus when the hand-sensor-means detects that there is no presence of hands in the vicinity of the outlet-means.

38. Apparatus of any one of the preceding claims wherein the bacteria-entrapment-filter-means includes an airborne-bacteria filter arrangement according to any one of claims 80 to 106.

39. A method of producing a stream of substantially sterilised, heated air from a sterilising hand-drying apparatus for drying hands, the method including:

- using airflow-generation-means to move air swiftly as an airflow;
- heating the air with heating-means so that the airflow is useable for drying hands;
- providing the hand-drying apparatus with bacteria-entrapment-filter-means through which, in use, the airflow passes; and

- wherein the bacteria-entrapment-filter-means, in use, is adapted to trap and retain therein a substantial portion of bacteria in the airflow, such that the airflow leaving the bacteria-entrapment-filter-means is more sterile than when entering the bacteria-entrapment-filter-means,

- the entrapment filter-means being in the form of a fibrous matrix that has on its fibres a toxic bacteria-killing substance which is able to kill any bacteria that impinges on the bacteria-killing substance on the fibres.

40. A method of claim 39 wherein the hand-drying apparatus is in accordance with any one of claims 1 to 38.

41. A sterilising hand-drying apparatus adapted to produce a stream of substantially sterilised, heated air for drying hands, the apparatus including:

- a housing;
 - heating-means positioned in the housing for heating of air useable for drying hands;
 - inlet-means through which the air, in use, enters the housing and travels to reach the heating-means;
 - outlet-means through which the air, in use, after being heated by the heating-means, is emitted as heated air useable for drying hands; and
 - airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-means via the heating-means to the outlet-means;
- wherein the apparatus is provided with an electric control circuit that supplies electrical power to the apparatus,
- and wherein the electric control circuit is provided with a cut-off mechanism that disables the supply of electrical power when the housing is opened so as to minimise risk of the user being electrocuted when opening the housing.

42. Apparatus of claim 41 wherein the cut-off mechanism includes a two-state switch which enables the supply of electrical power only when in the first state, and wherein an actuator is provided within the housing that maintains the switch in the first state when the housing is closed, and which activates the switch into the second state when the housing is opened to thereby disable the supply of electrical power to the apparatus when the housing is opened.

43. Apparatus of claim 41 wherein the cut-off mechanism includes a resiliently-mounted switch which enables the supply of electrical power only when activated, and wherein a cut-off-mechanism-activator is provided within the housing and arranged so as to activate the switch when the housing is closed, and to deactivate the switch when the housing is opened thereby to disable the supply of electrical power to the apparatus when the housing is opened.

44. Apparatus of claim 43 wherein the resiliently-mounted switch is mounted on a base-mounting to which a hood of the housing is removably attachable, and the cut-off-mechanism-activator is mounted on an interior surface of the hood.

45. Apparatus of claim 43 wherein the cut-off-mechanism-activator is mounted on a base-mounting to which a hood of the housing is removably attachable, and the resiliently-mounted switch is mounted on an interior surface of the hood.

46. Apparatus of claim 44 or 45 wherein the cut-off-mechanism-activator is in the form of a depressor that activates the cut-off mechanism when in contact therewith.

47. Apparatus of claim 44 or 45 wherein the base-mounting is adapted to be fastened to an upright mounting surface, such that the hand-drying apparatus is able to be installed onto the upright mounting surface by attaching the housing to the base-mounting.

48. A baseplate to which a hood of a housing of a sterilising hand-drying apparatus is adapted to be removably attached,

wherein the hand-drying apparatus is provided with an electric control circuit that supplies electrical power to the apparatus,

and wherein the baseplate is provided with a cut-off mechanism that disables the supply of electrical power to the electric control circuit when, in use with the hood attached to the baseplate, the housing is opened so as to minimise risk of the user being electrocuted when opening the housing.

49. A baseplate of claim 48 wherein the sterilising hand-drying apparatus is in accordance with any one of claims 41 to 47.

50. A baseplate of claim 48 or 49 wherein the hand-drying apparatus is in accordance with any one of claims 1 to 25, or any one of claims 33 to 38.

51. A sterilising hand-drying apparatus adapted to produce a stream of substantially sterilised, heated air for drying hands, the apparatus including:

a housing;

heating-means positioned in the housing for heating of air useable for drying hands;

inlet-means through which the air, in use, enters the housing and travels to reach the heating-means;

outlet-means through which the air, in use, after being heated by the heating-means, is emitted as heated air useable for drying hands; and

airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-means via the heating-means to the outlet-means;

wherein the hand-drying apparatus is provided with a timer-control-circuit to regularly auto-activate the airflow-generation-means for a predetermined period of time.

52. Apparatus of claim 51 wherein the timer-control-circuit auto-activates the apparatus without concurrently activating the heating-means.

53. Apparatus of claim 51 wherein the timer-control-circuit auto-activates the apparatus while concurrently activating the heating-means.

54. Apparatus of any one of claims 51 to 53 wherein the timer-control-circuit is provided with light-sensor-means and only auto-activates the apparatus only the light-sensor indicates that there is ambient light.

55. Apparatus of any one of claims 51 to 54 wherein the apparatus is provided with hand-sensor-means which detects the presence of hands in the vicinity of the outlet-means and is adapted to activate the airflow-generation-means and the heating-means when hands are so detected, and wherein the timer-control-circuit only auto-activates the apparatus when the hand-sensor-means detects that there is no presence of hands in the vicinity of the outlet-means.

56. Apparatus of any one of the claims 51 to 55 wherein the apparatus is provided with a fragrance-material that is a source of fragrance so that the fragrance infuses into the airflow.

57. A timing circuit component adapted to regularly auto-activate airflow-generation-means in a sterilising hand-drying apparatus for a predetermined period of time,

the sterilising hand-drying apparatus adapted to produce a stream of substantially sterilised, heated air for drying hands, the apparatus including:

a housing;

heating-means positioned in the housing for heating of air useable for drying hands;

inlet-means through which the air, in use, enters the housing and travels to reach the heating-means;

outlet-means through which the air, in use, after being heated by the heating-means, is emitted as heated air useable for drying hands; and

said airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-means via the heating-means to the outlet-means;

wherein the timer-control-circuit is adapted to regularly auto-activate the airflow-generation-means for a predetermined period of time.

58. A timing circuit component of claim 57 wherein the hand-drying apparatus is in accordance with an apparatus of any one of claims 51 to 56, or any one of claims 1 to 32.

59. A method of sterilising ambient atmosphere around a sterilising hand-drying apparatus that is adapted to produce a stream of substantially sterilised, heated air for drying hands, the method including:
- providing the hand-drying apparatus with a timer-control-circuit that is adapted to regularly auto-activate the airflow-generation-means for a predetermined period of time; and
 - using the timer-control-circuit to auto-activate the sterilising hand-drying apparatus periodically for a predetermined period of time,
- wherein the hand-drying apparatus includes:
- a housing;
 - heating-means positioned in the housing for heating of air useable for drying hands;
 - inlet-means through which the air, in use, enters the housing and travels to reach the heating-means;
 - outlet-means through which the air, in use, after being heated by the heating-means, is emitted as heated air useable for drying hands; and
 - airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-means via the heating-means to the outlet-means.
60. A method of sterilising ambient atmosphere wherein the hand-drying apparatus is in accordance with any one of claims 51 to 56, or any one of claims 1 to 32.

61. A method of fragrancing ambient atmosphere around a hand-drying apparatus that is adapted to produce an airflow of heated air for drying hands, the method including:

providing the hand-drying apparatus with a timer-control-circuit that is adapted to regularly auto-activate the airflow-generation-means for a predetermined period of time;

providing the apparatus with a fragrance-material that is a source of fragrance so that the fragrance infuses into the airflow; and

using the timer-control-circuit to auto-activate the hand-drying apparatus periodically for a predetermined period of time, which effectively causes the fragrance in the airflow to fragrance the ambient atmosphere around the hand-drying apparatus;

wherein the hand-drying apparatus includes:

a housing;

heating-means positioned in the housing for heating of air useable for drying hands;

inlet-means through which the air, in use, enters the housing and travels to reach the heating-means;

outlet-means through which the air, in use, after being heated by the heating-means, is emitted as heated air useable for drying hands; and

airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-means via the heating-means to the outlet-means.

62. A method of fragrancing ambient atmosphere wherein the hand-drying apparatus is in accordance with any one of claims 51 to 56, or any one of claims 1 to 32.

63. A sterilising hand-drying apparatus adapted to produce a stream of substantially sterilised, heated air for drying hands, the apparatus including:

a housing;

heating-means positioned in the housing for heating of air useable for drying hands;

inlet-means through which the air, in use, enters the housing and travels to reach the heating-means;

outlet-means through which the air, in use, after being heated by the heating-means, is emitted as heated air useable for drying hands;

airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-means via the heating-means to the outlet-means; and

filter material adapted to filter the airflow;

wherein the apparatus includes a filter-replacement mechanism that is able to automatically replace the filter material in use with replacement filter material.

64. Apparatus of claim 63 wherein the filter-replacement mechanism replaces the filter material in use with replacement filter material periodically after a period of time.

65. Apparatus of claim 63 wherein the filter-replacement mechanism replaces the filter material in use with replacement filter material progressively in a continuous or intermittent manner.

66. Apparatus of claim 65 wherein the filter material is in the form of a sheet-like strip.

67. Apparatus of claim 66 wherein the filter material is conveyed by a motorised reel-mechanism.

68. Apparatus of any one of claims 63 to 67 wherein the filter material includes bacteria-entrapment-filter-means through which, in use, the airflow passes, and

wherein the bacteria-entrapment-filter-means, in use, is adapted to trap and retain therein a substantial portion of bacteria in the airflow, such that the airflow leaving the bacteria-entrapment-filter-means is more sterile than when entering the bacteria-entrapment-filter-means.

69. Apparatus of claim 68 wherein sterilising hand-drying apparatus is in accordance with any one of claims 2 to 20, or any one of claims 26 to 38.

70. An auto filter-replacement mechanism to change filter material of a sterilising hand-drying apparatus,

wherein the filter-replacement mechanism is in accordance with the filter-replacement mechanism recited within any one of claims 64 to 68.

71. A sterilising hand-drying apparatus adapted to produce a stream of substantially sterilised, heated air for drying hands, the apparatus including:

a housing;

heating-means positioned in the housing for heating of air useable for drying hands;

inlet-means through which the air, in use, enters the housing and travels to reach the heating-means;

outlet-means through which the air, in use, after being heated by the heating-means, is emitted as heated air useable for drying hands; and

airflow-generation-means adapted to move the air swiftly as an airflow from the inlet-means via the heating-means to the outlet-means;

wherein the inlet-means includes at least one main entrance through which all airflow in the apparatus must pass through said at least one main entrance, and

wherein the at least one main entrance is located in an entrance into the airflow-generation-means such that all air entering the airflow-generation-means passes through this at least one main entrance which is filtered.

72. Apparatus of claim 71 wherein the airflow-generation-means is contained in a casing and wherein said at least one main entrance is located on the casing.

73. Apparatus of claim 71 wherein the at least one main entrances is located totally inside the housing.

74. Apparatus of claim 71 wherein the at least one main entrance is located on the housing of the apparatus, and wherein all other entrances into the housing, apart from said at least one main entrance, are sealed so that, in use, air can only enter the housing through said at least one main entrance.

75. Apparatus of any one of claims 71 to 74 wherein the inlet-means includes one or more secondary entrances arranged in series with the main entrance through which the airflow passes sequentially one after another.

76. Apparatus of claim 75 wherein main entrance is separated from its next nearest entrance in the series by a substantial space that contains sufficient air to satisfy the air intake requirements of the airflow-generation-means in terms of volume of air per unit time.

77. Apparatus of claim 75 or 76 wherein at least one of the secondary entrances is located on an external surface of the housing, and accessible by the user from outside of the housing.
78. Apparatus of any one of claims 71 to ~~77~~ wherein the sterilising hand-drying apparatus is in accordance with any one of claims 1 to 7, or any one of claims 26 to 38.
79. A sterilising hand-drying apparatus of any one of the preceding claims wherein the bacteria-entrapment-filter-means is in the form of an airborne-bacteria filter arrangement of any one of claims 80 to 106.

80. An airborne-bacteria filter arrangement adapted to be used with an apparatus that draws in and expels an airflow into a human-activity environment, the filter arrangement including the following through which the airflow passes in sequence:

i) entrapment filter-means in the form of a fibrous matrix that has on its fibres a toxic bacteria-killing substance which is able to kill any bacteria that impinges on the bacteria-killing substance on the fibres.

81. A filter arrangement of claim 80 wherein, after the entrapment filter-means, the airflow passes through:

ii) carbon filter-means that intercepts and removes from the airflow any of the toxic bacteria-killing substance that originates from the entrapment filter means so that the airflow leaving the filter arrangement into the human-activity area is substantially free both of bacteria and of traces of the bacteria-killing substance.

82. A filter arrangement of claim 81 wherein the airborne-bacteria filter arrangement is located fully inside the apparatus interior.

83. A filter arrangement of claim 82 wherein the filter arrangement is provided with filter-barrier-means which, in use, houses the entrapment filter means and the charcoal-filter-means so as to provide a bacteria-impermeable barrier therefor.

84. A filter arrangement of claim 83 wherein the bacteria-impermeable barrier of the filter-barrier-means separates the entrapment filter means and the charcoal-filter-means from the interior of the apparatus such that, in use with the airflow, bacteria or other contaminants inside the apparatus can only enter the filter arrangement via the entrapment filter means and not through other parts of the filter arrangement.

85. A filter arrangement of claim 83 wherein the bacteria-impermeable barrier includes components that are adapted to fit together such that, when fitted together, bacteria cannot enter the interior of the filter arrangement through points of abutment of the components.

86. A filter arrangement of claim 83 wherein the bacteria-impermeable barrier of the filter-barrier-means also prevents any live bacteria inside the filter arrangement from escaping therefrom back into the apparatus interior.

87. A filter arrangement of any one of claims 81 to 86 wherein the entrapment filter means and the charcoal-filter-means are separated by a volumetric region that is sealed within the bacteria-impermeable barrier such that the volumetric region acts as an interim destination for the airflow to enter after leaving the entrapment filter means.
88. A filter arrangement of claim 87 wherein the entrapment filter means and the charcoal-filter-means are generally parallel to one another such that the volumetric region therebetween is a flat and planar-like.
89. A filter arrangement of claims 87 or 88 wherein, in use, the airflow leaves the entrapment filter means and enters the charcoal-filter-means in a manner that the airflow is substantially perpendicular to the surfaces of each of the filter-means.
90. A filter arrangement of any one of the preceding claims wherein the entrapment filter means and the charcoal-filter-means are followed next, in sequence, by an emitting-filter-means containing a beneficial emittable-substance which, in use, is infused into the airflow expelled from the filtration arrangement.
91. A filter arrangement of claim 90 wherein the entrapment filter means and the charcoal-filter-means are followed next, in sequence, by two or more emitting-filter-means each containing a different beneficial emittable-substance which, in use, is infused into the airflow expelled from the filtration arrangement.
92. A filter arrangement of claim 90 or 91 wherein the beneficial emittable-substance includes a pharmaceutical that is able to be administered to a user in an airborne manner.
93. A filter arrangement of claim 90 or 91 wherein the beneficial emittable-substance includes a fragrance.
94. A filter arrangement of claim 90 or 91 wherein the beneficial emittable-substance includes an anti-bacterial substance.
95. A filter arrangement of claim 90 or 91 wherein the beneficial emittable-substance is combined with an air-flow activated composition of claims 113 to 118 wherein the beneficial emittable-substance is the active substance.

96. A filter arrangement of claim 90 or 91 wherein at least the emitting-filter-means is in the form of a flat piece of filter material that is supported in the filter arrangement such that the flat piece is able to flutter in the airflow.
97. A filter arrangement of any one of the preceding claims 80 to 96 wherein the bacteria-killing substance is a liquid-applied substance which, when on the fibre, presents a sticky coating on the fibre which captures bacteria that impinges on the bacteria-killing substance found on the fibres.
98. A filter arrangement of any one of the preceding claims 80 to 97 wherein the sticky coating is able to physically hold impinging bacteria particles to the fibre so that the bacteria are held and killed in that location.
99. A filter arrangement of any one of the preceding claims 81 to 98 wherein the charcoal filter-means is a fibrous matrix infused with charcoal particles.
100. A filter arrangement of any one of the preceding claims 81 to 99 wherein the charcoal-filter-means re-oxygenates the airflow and removes odours.
101. A filter arrangement of any one of the preceding claims 81 to 100 wherein each of the filters is housed in a filter-holder, and where each of the filter-holders is provided with attachment-sequence-means that ensure that the filters can only be attached one to the other in the aforesaid sequence.
102. A filter arrangement of claim 101 wherein, when each of the filters holders is attached to one of the other in the aforesaid sequence, the filter-holders combine to provide said bacteria-impermeable barrier.
103. A filter arrangement of claim 101 wherein the attachment-sequence-means on each filter-housing is in the form of a shaped contour that can only mate precisely with a corresponding contour on the filter-housing that is next in the aforesaid sequence.
104. A filter arrangement of claim 103 wherein the filter-holders fit together in the aforesaid sequence to form a stack.
105. A filter arrangement of any one of the preceding claims 80 to 104 wherein the fibrous matrix is adapted to physically capture bacteria particles and, at the same time, also to present minimal impedance to the airflow, and, as such, the fibrous matrix is therefore characterised by:

average gaps or pores between the fibres that are very significantly larger than the size of bacteria so as to present minimal impedance to the airflow; and

a tortuous path for the airflow created by the fibrous matrix so that the bacteria particles have an extremely high probability of impacting at least some of the fibres of the matrix.

106. A filter arrangement of claim 105 wherein the average gaps or pores between the fibres is selected to be around 150 microns.

107. A filter arrangement of any one of the preceding claims 80 to 106 wherein the apparatus is a hand-dryer.

108. A filter arrangement of any of any one of the preceding claims 80 to 106 wherein the apparatus is a hand-dryer and wherein the apparatus is in accordance with any one of claims 1 to 38, or of claims 41 to 56, or of claims 63 to 69, or of claims 71 to 79.

109. A filter arrangement of any one of the preceding claims 80 to 106 wherein the apparatus is a vacuum cleaner.

110. A filter arrangement of any one of the preceding claims 80 to 106 wherein the apparatus is a hair dryer.

111. A filter arrangement of any one of the preceding claims 80 to 106 wherein the apparatus is an air conditioner.

112. A filter arrangement of any one of the preceding claims 80 to 106 wherein the apparatus is an clothes dryer.

113. An air-flow activated composition including:
an active substance capable of becoming airborne at least for a useful period of time; and
a release agent to restrain the active substance from becoming airborne at normal room temperature and pressure,
wherein upon exposure of the composition to flowing air, the release agent will release the active ingredient into the air stream.
114. A composition according to claim 113, wherein the active substance is a biocide and/or a fragrance.
115. A composition according to claim 113 or 114, wherein the release agent is a microporous polymer.
116. A composition according to claim 113 or 114, wherein the release agent is a microcapsule polymer shell.
117. A composition according to claim 116, wherein the release agent is a melamine-formaldehyde microencapsulate shell.
118. A composition according to claim 117, wherein the shells range in size between 5-100µm micrometers.
119. A filter substrate treated with the composition of any one of claims 113 to 118.
120. A filter according to claim 119, wherein the composition is sprayed on to the substrate in a liquid emulsion.
121. A filter according to claim 120, installed in an air blowing device whereby air passed over or through the filter whereby to release the active substance.
122. Use of a composition of any one of claims 113 to 118 on the filter arrangement of an airborne-bacteria filter arrangement of any one of claims 81 to 111.