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(54) MICRO-PERFORATED CHANNEL FOR AIR DISTRIBUTION

(57) *Micro-perforated channel (100, 101) for air distribution having a plurality of tube pieces (10) stably connected to each other, a plurality of holes (11) and an antibacterial inner coating, said micro-perforated channel (100, 101) further having a density of the plurality of holes (11) between 5% and 10% of the entire surface of the channel (100, 101) micro-perforated so as to allow the generation of turbulent motions inside the channel (100, 101) and at the same time keeping intact the characteristics of the antibacterial coating to prevent the rooting of impurities and bacteria.*

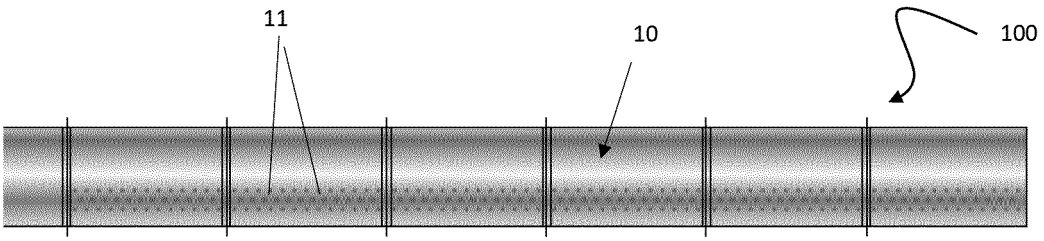

Fig. 1

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Description

Technical field of the invention

[0001] The present invention relates to an innovative micro-perforated channel for air distribution, having antibacterial features.

Background art

[0002] The quality of the conditioned air conveyed in rooms is nowadays an aspect of primary importance in the choice of clients, designers and installers. A high level of hygiene must be guaranteed by all components of the air conditioning system, including the air distribution channels.

[0003] Micro-perforated channels for the distribution of an air flow, e.g. treated air to condition a room: cooled air, heated air and the like, are known in the state of the art. Normally, air distribution systems comprise a suitable canalization by means of which an air flow is transferred from a device designed to supply energy to the air flow in the form of a pressure increase (e.g. a fan) to an area of use of the air flow, such as a particular room, an office, a laboratory, a workshop or the like.

[0004] Furthermore, such canalization generally comprises one or more sheet metal transport channels and one or more terminal venting elements, such as perforated diffuser channels made of sheet metal or flexible materials, for example fabrics. In particular, the diffuser channels, whether made of metal or flexible materials, have the task of homogeneously distributing the air in the area of use and, for this purpose, are provided by a plurality of holes arranged along one or more walls of the channel.

[0005] Channels of the known type, along with large flows of air also distribute large flows of dust particles and along with them also mites, bacterial and viral particles. Internal coatings of such channels with antibacterial materials are also known, e.g. paint applied to the inside of the channel. The components of the paint inhibit the proliferation of colonies of the most common types of bacteria and contribute to their destruction. Tests in accordance with ISO 22196:2007 carried out in specialized laboratories have shown effective action in reducing colonies of the following bacteria by more than 99.99% within 24 hours: Staphiloccous Aureus, Escherichia Coli O1257, Legionella Pneumophila, Salmonella Enteritidia, Pseudominas aeruginosa, Enterobacter Aerogenes, Enterococcus Faecalis.

[0006] Antimicrobial coated channels are therefore suitable for use in public places such as schools, hotels, cinemas, theatres and offices, but especially in places where hygiene is essential: hospitals, operating theatres, food industries and pharmaceutical industries. Antimicrobial canalization can also be a great help to all those who suffer from allergies, asthma and chronic respiratory problems, allowing them to have a healthier and quieter life at home. However, channels with a known antibacterial or antimicrobial coating cannot completely prevent the formation of colonies and clusters of bacteria and mites within them.

This is due to the fact that the methods commonly used for creating the perforation in channels with an antibacterial or antimicrobial coating fail to keep the edges of the hole intact, inevitably also removing part of the antibacterial treatment from these edges, thus making them areas in which bacteria and microbes easily nest.

There is, therefore, a need to realize an innovative air distribution channel which is extremely efficient and able to reduce as much as possible the formation and diffusion of bacterial and microbial particles.

Summary of the invention

[0007] The aim of the present invention is to optimize micro-perforated air distribution channels with an antibacterial coating in order to minimize the formation of colonies and clusters of bacteria and mites inside them.

[0008] This aim, which is the main purpose of the present invention, is achieved by optimizing the number, i.e., the density, and the shape characteristics of the air outlet holes in the channels themselves.

[0009] A specific calculation algorithm makes it possible to calculate an optimal perforation density with respect to the surface of the channel, so that the necessary amount of antibacterial coating is preserved inside the tube.

[0010] In addition, the calculation algorithm makes it possible to calculate and establish the optimal distribution of the air and therefore of the summer/winter comfort in the treated environments, limiting the phenomena of stratification and excessive residual velocities at human height. In particular, the specific perforation made will avoid the formation of condensation both inside and outside the channel itself.

[0011] The micro-perforated channels, which are the subject of the present invention, are therefore designed to maximize the principle of induction of the conditioned air, which depends on the speed of the air flow and serves to reduce the mixing time between the outgoing air and the surrounding air, thus limiting the effect of air stratification present in conventional systems. The application of this feature to the channels makes it possible to move many more volumes of air than those introduced (from 5 to 20 times depending on the type of system) and consequently the diffusion in the environment is more homogeneous compared to traditional systems with diffusers or vents. Furthermore, by drastically reducing stratification, the time required to set up and maintain the system is reduced.

[0012] Advantageously, the micro-perforation carried out on the channels allows the air to flow inside the channel, creating special swirling motions, and then escape from the channel and diffuse into the area of use.

[0013] Therefore, the micro-perforated channel object

of the present invention, is configured to extremely efficiently prevent the proliferation of bacteria, as specified in the attached independent product claim.

[0014] According to another purpose, the making of the channels is carried out by means of a specific method according to the attached independent method claim.

[0015] According to a further purpose, an aeration system comprising a plurality of micro-perforated channels is defined according to the attached independent system claim.

[0016] Further preferred and/or particularly advantageous ways of implementing the invention are described according to the features set out in the attached dependent claims.

Brief description of the drawings

[0017] The invention will now be described with reference to the appended drawings, which illustrate some non-limiting implementation examples, wherein:

- figure 1 shows a micro-perforated channel in a first embodiment according to the present invention;
- figure 2 shows a micro-perforated channel in a further embodiment, according to the present invention;
- figure 3 is an overall view of the micro-perforated channel system in an aeration system, according to the present invention,
- figure 4 is a table relating the dimensioning of the diameter of the micro-perforated channel in relation to the required flow rate,
- figure 5 shows the fixing system of a micro-perforated channel, according to the present invention,
- figure 6 shows the punch and the special die used for perforating the sheet metal with antimicrobial treatment.

Detailed description

[0018] With reference to the above figures, Figures 1 and 2 show a micro-perforated channel 100, 101 for distributing air, according to two embodiments of the present invention. The channel 100 is a channel with a constant diameter, while the channel 101 is a channel with a variable diameter.

[0019] The channel 100 comprises: a plurality of pipe sections 10 stably connected to each other, a plurality of openings or holes 11 and an antibacterial inner lining (of known type and therefore not shown in the appended figures).

[0020] The channel 101 also comprises a plurality of metallic pipe sections 10, but having variable diameters and joined together by means of truncated cone fittings 12. It also comprises the plurality of openings or holes 11 and the antibacterial inner coating. The anti-bacterial coating is achieved by applying a paint with anti-bacterial properties to one side of the metal surface, which once folded will form the plurality of pipe sections 10, i.e. the portion that will form the inner surface of the channel 100, 101. The painting treatment of the metal sheet (inner part of the channel) is carried out with a special material with antimicrobial properties. The treatment is carried out in the following stages

- carry out two degreases and a chrome-free passivation;
- apply a 5-7 micron thick "primer" to the upper face and then apply a 15-20 micron thick white top coat. or, alternatively
- apply a 5-7 micron thick "primer" to the upper face (steel only), then apply a 10-15 micron thick PE base coat and finally apply a 12 micron thick clear topcoat.
- on the lower face apply a "back coat" with a thickness of 4-6 microns.

[0021] This treatment gives a UV resistance category: RUV2, a corrosion resistance category: RC2 and a fire category: A1, according to EN 13501-1. The paint used complies with the ROHS directive.

[0022] The channel 100, 101, subject of the present invention, has along the entire length of the pipe sections 10 a plurality of holes 11 obtained through the use of a specific punch. In other words, the punch used is able to make a suitable perforation, in order to obtain the specific air induction characteristics, without affecting and excessively reducing the removed surface of the channel. In particular, its punching action makes it possible to obtain a precise hole that creates less waste, thus minimizing the breakage of the antibacterial coating.

[0023] The use of a specific punch in the presence of the plurality of holes lion the channel 100, 101 is therefore indispensable for all sections of the channel, so as to prevent the rooting of impurities and bacteria even in the areas of the holes 11.

[0024] The punch 50 and its die 60 as shown in Figure 6 are characterised by a reduced clearance of between 15% and 20% compared to standard tools. According to a non-limiting example, the backlash of the standard die 60 is 0.18 mm, whereas the backlash of the die 60 of the punch 50 used in the present invention is 0.15 mm.

[0025] Such holes 11, should be made with a drilling density of between 5% and 10% of the entire surface of the channel 100, 101. Advantageously, as shown by statistical and experimental data, this drilling density is 7% of the entire surface of the channel 100, 101.

[0026] This optimization of the perforation density is fundamental in order to balance two characteristics which are in trade-off: on the one hand the air circulation and on the other hand the quantity of antibacterial coating inside the tube. Obviously, as the perforation density increases, air circulation increases and the effectiveness of the antibacterial coating decreases. The optimum perforation density value can be obtained by means of a calculation algorithm implemented on a special software application.

[0027] Advantageously, the presence of a plurality of

efficiently distributed holes 11 allows for turbulent motions within the channel 100, 101 so as to prevent the formation of moisture and optimal circulation of the outgoing air both inside and outside the channel itself.

[0028] Advantageously, the channel 100 are made, for example, of galvanized sheet metal, or galvanized sheet metal painted in colors according to RAL color scale coding.

[0029] Advantageously, the presence of the holes 11 generates a more homogeneous diffusion of air to the outside environment, compared to conventional diffusers.

[0030] By means of the aforementioned calculation algorithm it is also possible to carry out the complete dimensioning of the channel 100, 101 and in particular the choice of the diameter of the piece of pipe 10, in the case of a constant diameter channel, or of the diameters of the single pieces of pipe 10 in the case of variable diameters. Furthermore, the software application is able to graphically show the air diffusion inside the treated room. Such calculations and visualizations make it possible to analyze in a punctual manner both the penetration of the treated air with respect to the volume of the room, and the isometric lines of speed. According to the present invention, the air outlet points or distribution holes are dimensioned taking into account the following parameters:

- air flow rate (summer/winter);
- useful head available to the system;
- length of the channel;
- height of the channel axis from the floor;
- distance from the ceiling;
- width of the area treated by the channel.

[0031] Thus proceeding, the software application can dimension an entire system 200 for air distribution, as shown in Figure 3. The system 200, comprises an air treatment unit 30 connected to a supply channel 20 also provided with antimicrobial treatment and a plurality of micro-perforated and antimicrobial channel 100, 101. The air handling unit is provided with a plurality of panels 35.

[0032] The panels 35 may be made of sheet metal having an antibacterial inner coating. The sheet metal having an antibacterial inner coating provides effective protection (e.g., certified according to JIS Z 2801:2000A and ISO 22196:2011-08) against a wide range of microorganisms, including:

- Escherichia Coli;
- Staphylococcus Aureus;
- Methicillin Resistant Staphylococcus Aureus (MRSA);
- Klebsiella Pneaumoniae;
- Salmonella Typhi;
- Enterococcus Faecalis;
- Pseudomonas Aeruginosa;
- Legionella Pneumophila.

[0033] The antibacterial coating is white with a smooth finish for ease of cleaning and washability.

[0034] Therefore, the air distribution system 200, equipped with both panels and channels with antibacterial internal treatment, ensures uniformity of antimicrobial treatment throughout the plant.

[0035] In addition, the table in Figure 4 shows an example of the sizing of channel 100, 101. The table shows the value of the channel diameter in the left column and the value of the air flow rate in the right column. For each diameter value the correct flow rate is indicated. In the design phase, the correct diameter is chosen as a function of the flow rate, while in the verification phase the flow rate corresponding to the chosen diameter can be found. This two-way correspondence of diameter <=> flow rate ensures that the channel is suitable for installation. For example, for a diameter of 200 mm the flow rate will be 790 Mc/h.

[0036] According to the present invention, a method for making a micro-perforated channel 100, 101 for air distribution is also described, comprising the following main steps:

- painting the sheet metal (inner part of the channel) with a paint having antimicrobial properties;
- punching the sheet metal to form the holes using a special punch;
- making interlocking profiles on the edges of the sheet;
- calendering the sheet metal to form the channel;
- close the interlocking profiles.

[0037] Furthermore, as shown in Figure 5, in order to obviate further perforations on the channel 100,101 required during installation of the channels on the ceiling, the channels 100, 101 may be provided with suitable anchorages 40. In particular, the anchorage 40 comprises a suspension means 41 surrounding the channel 100, 101 in turn closed by a locking means 42 and fixed by an anchoring means 43 to the ceiling.

[0038] In addition to the methods of implementing the invention, as described above, it is to be understood that there are numerous further variants. It should also be understood that the above-described embodiments are merely illustrative and do not limit the subject matter of the invention, nor its possible applications or configurations. On the contrary, although the above description makes it possible for a person skilled in the art to implement the present invention at least according to an exemplary configuration thereof, it should be understood that numerous variations of the described components are conceivable, without thereby departing from the subject of the invention as defined in the appended claims.

Claims

1. Micro-perforated channel (100, 101) for air distribution comprising a plurality of pipe sections (10) steadily connected to each other, a plurality of holes (11) and an antibacterial internal coating, said micro-perforated channel (100, 101) being **characterized by** the fact that the density of the plurality of holes (11) is between 5% and 10% of the entire surface of the micro-perforated channel (100, 101) so as to guarantee the generation of turbulent motions inside the micro-perforated channel (100, 101) and at the same time keep the characteristics of the antibacterial coating intact to prevent the rooting of impurities and bacteria.

2. Micro-perforated channel (100, 101) according to claim 1, **characterized by** the fact that the density of the plurality of holes (11) is exactly equal to 7% of the entire surface of the micro-perforated channel (100, 101).

3. Micro-perforated channel (100, 101) according to claim 1 or 2, further provided with an anchorage (40) comprising a suspension means (41) surrounding the micro-perforated channel (100, 101) which is in turn closed by a locking means (42) and secured by an anchoring means (43) to the ceiling.

4. Micro-perforated channel (100) according to any of the preceding claims, wherein the plurality of pipe sections (10) has a constant diameter.

5. Micro-perforated channel (101) according to any one of claims 1 to 3, wherein the plurality of pipe sections (10) has a variable diameter and the individual pipe sections (10) are joined together by means of truncated cone fittings (12).

6. Air distribution system (200) comprising an air treatment unit (30), provided with a plurality of panels (35), connected to a supply channel (20) also provided with antimicrobial treatment and **characterized by** antimicrobial treatment and **characterized by** a plurality of micro-perforated channels (100, 101) micro-perforated as defined according to any of the preceding claims.

7. Air distribution system (200) according to claim 6, wherein the plurality of panels (35) is made of sheet metal provided with an inner antibacterial coating.

8. Method for realizing a micro-perforated channel (100, 101) as defined according to any of claims from 1 to 5, said method being **characterized by** the following steps:

- painting the metal sheet (inner part of the channel) with a paint having antimicrobial properties;
- punching the metal sheet to form the holes by means of a specific punch **characterized by** a clearance of the die equal to 0.15 mm;
- making interlocking profiles on the edges of the sheet;
- calendering the sheet to form the channel;
- closing the interlocking profiles.

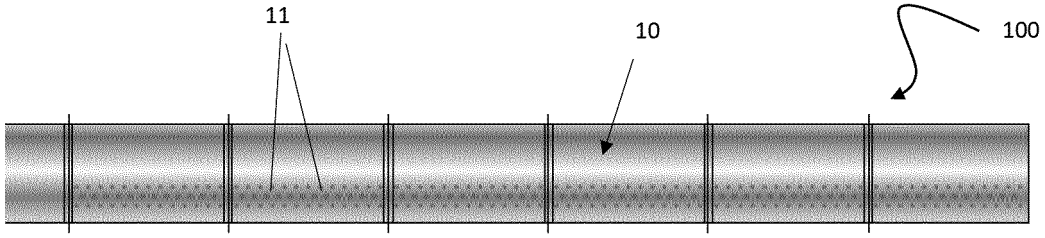

Fig. 1

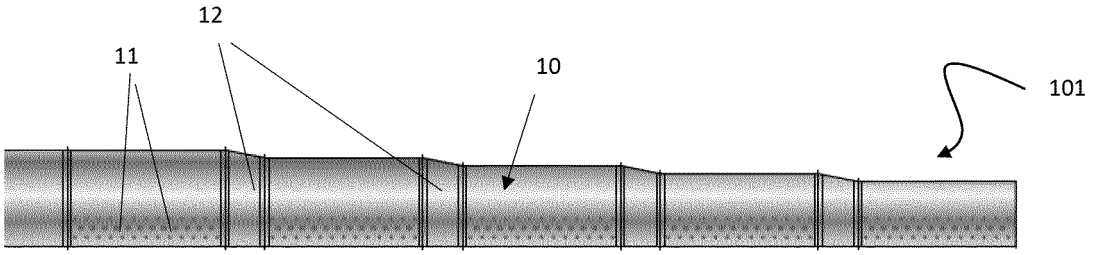

Fig.2

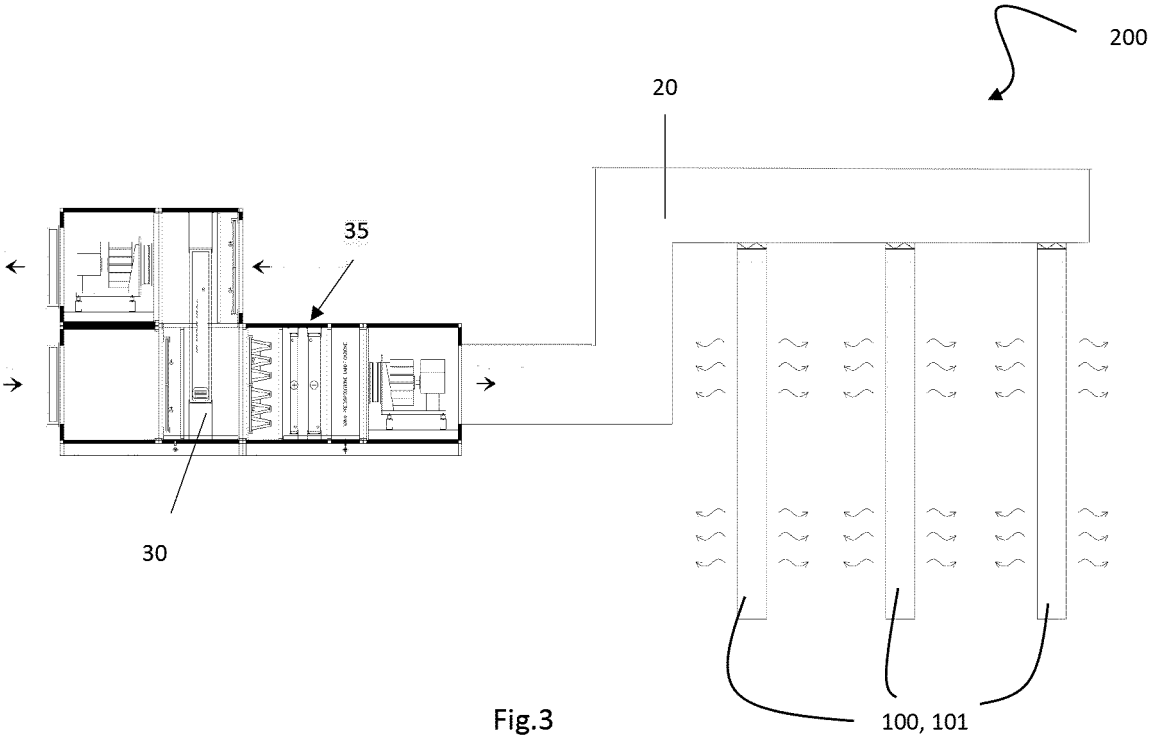

Fig.3

DIAMETRO	PORTATA
mm	Mc/h
200	790
250	1235
300	1780
350	2425
400	3165
450	4005
500	4945
550	5985
600	7120
650	8360
700	9695
750	11125
800	12660
850	14290
900	16025
950	17885
1000	19782
1100	23935
1250	30910

Fig.4

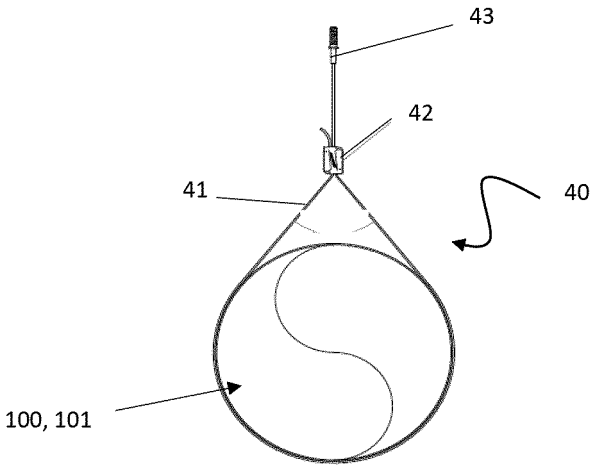

Fig. 5

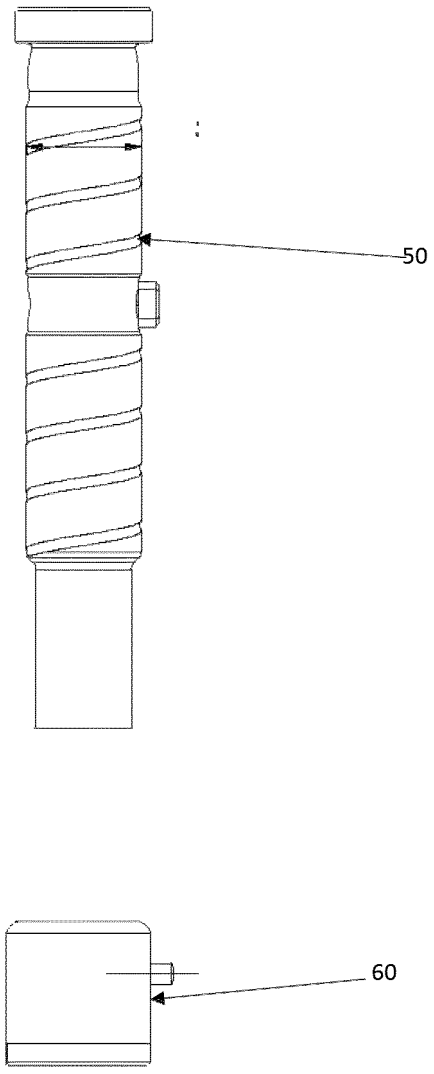

Fig.6

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EUROPEAN SEARCH REPORT

Application Number
EP 21 16 8801

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	9 August 2021	Anconetani, Mirco

CATEGORY OF CITED DOCUMENTS

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