US 20140056578A1

(19) **United States**

(12) **Patent Application Publication**

Rødbro

(10) **Pub. No.: US 2014/0056578 A1**

(43) **Pub. Date: Feb. 27, 2014**

(54) **HEATING FAN**

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(21) Appl. No.: **13/984,130**

(22) PCT Filed: **Feb. 7, 2012**

(86) PCT No.: **PCT/DK12/50045**

§ 371 (c)(1),
(2), (4) Date: **Oct. 22, 2013**

(30) **Foreign Application Priority Data**

Feb. 7, 2011 (DK) ..... PA 2011 00078

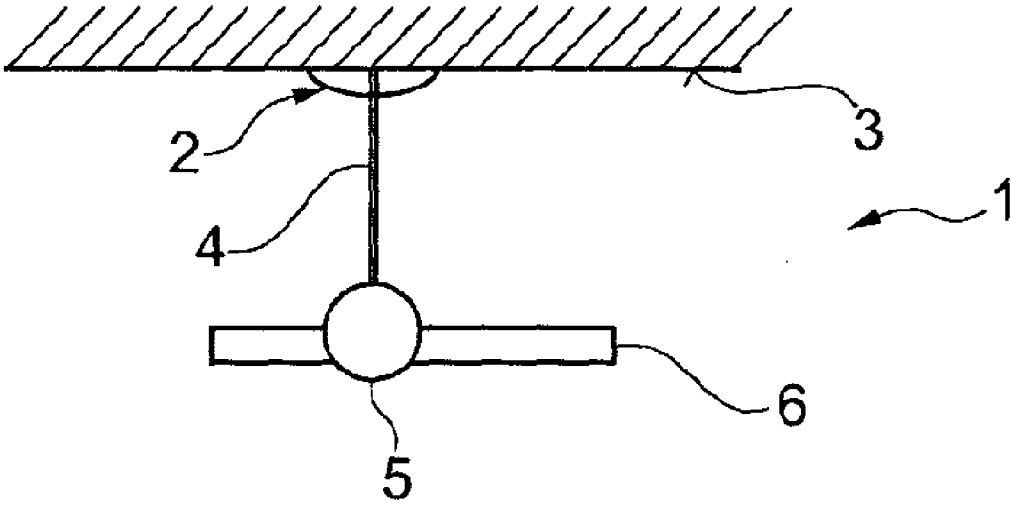
Publication Classification

(51) **Int. Cl.**
F24H 3/04 (2006.01)
F01D 5/14 (2006.01)

(52) **U.S. Cl.**
CPC ***F24H 3/0411*** (2013.01); ***F01D 5/147*** (2013.01)
USPC ..... **392/362**; 416/241 R

(57) **ABSTRACT**

A heating fan has a fastening means for fastening of said fan to a first surface. A stem connects the fastening means to a hub. The hub has a motor unit. The motor unit rotates a plurality of wings extending radially from said hub. The wings have upper and lower surfaces. Each wing has a leading edge and a trailing edge, defining upper and lower surfaces therebetween. At least one wing has electrical heating means integrated or connected to the upper surface. At least more than half the length of the leading and/or trailing edge is bent downwards relative to the surface of the wing.



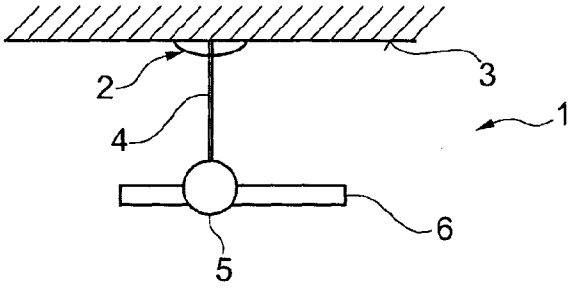


Fig. 1

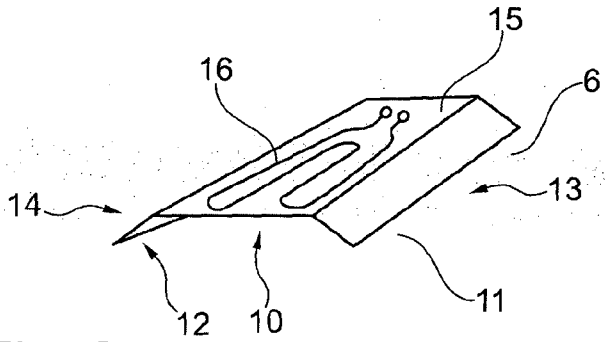


Fig. 2

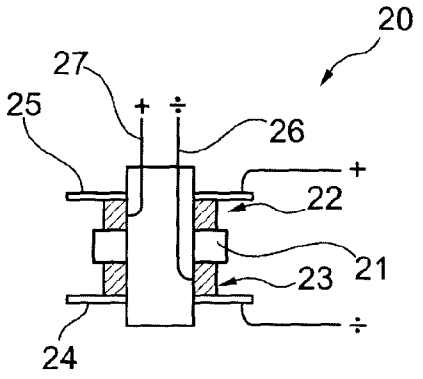


Fig. 3

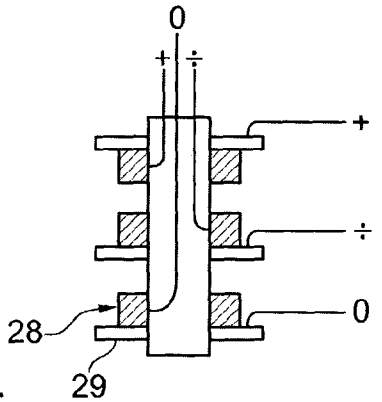


Fig. 4

HEATING FAN

FIELD OF THE INVENTION

[0001] The present invention relates to a heating fan.

BACKGROUND OF THE INVENTION

[0002] In the art there are a large number of fans for circulating or moving air.

[0003] A special segment of all these fans is provided with heating means such that as the fan is activated the air which the blades/wings of the fan engage will be heated thereby increasing the overall room temperature. Examples of fans incorporating heating means are found in US 2009/0116961, U.S. Pat. No. 4504191, U.S. Pat. No. 449414.

[0004] A common problem with fans of this type is the ability to transfer heat from the heating elements to the air which comes into contact with the blades and at the same time distribute the air more evenly around the room than just in front or below the fan blades which will otherwise be the case. These problems have unsuccessfully been addressed in the art, for example in U.S. Pat. No. 4867643, US 2006/0110257.

[0005] Although some of the prior art documents realize that in order to be able to transfer heat from a heating element arranged on a blade on a fan of the type mentioned above it is desirable to create turbulence adjacent the wing blades. The means for creating the desired turbulence often conflicts with the desire to be able to distribute the heated air to a larger area or to minimize the energy necessary in order to rotate the blades at a speed where the air put in motion by the blades may be able to reach further than just in front of the fan.

OBJECT OF THE INVENTION

[0006] Consequently, it is an object of the present invention to provide a fan which addresses the problems in the prior art and at the same time provides further advantages.

DESCRIPTION OF THE INVENTION

[0007] The invention addresses this by providing a heating fan, where said fastening means for fastening of said fan to a first surface, a stem connecting the fastening means to a hub, where said hub comprises a motor unit, where said motor unit rotates a plurality of wings extending radially from said hub, such that the wings have an upper and a lower surface, characterised in that each wing has a leading and trailing edge, defining upper and lower surfaces there between where at least one wing has electrical heating means integrated or connected to said upper surface, where at least more than half the length of the leading and/or trailing edge is bent downwards relative to the surface of the wing.

[0008] By simply bending an area adjacent the leading and trailing edges of the blade slightly out of plane relative to the main area of the surface of the wing, turbulence is created across the surface of the wing whereby optimal heat exchange properties are created in front of the heating element arranged on the surface of the wing.

[0009] At the same time the main area of the wing is maintained relatively flat such that the engagement with the air to be moved is relatively high whereby an effective air distribution is effected.

[0010] In a further advantageous embodiment of the invention the wing profile in a cross section perpendicular to the radial extent of the wing relative to the hub comprises three distinct substantially linear sections, a first linear section extending between 5 to 25 mm from the leading edge and a second linear section extending between 5 to 25 mm from the trailing edge, and a third linear section arranged between the first and second sections, where said third linear section has an extent between 35 and 110 mm, where the first and second linear sections are angled 5° to 60° relative to the third section.

[0011] The actual dimensions recited in this embodiment ensures that sufficient surface space is provided for the heating element such that a substantial amount of energy may be provided for the contact zone between the air and the wing and at the same time enough wing area is provided in order to move the air coming into contact with the heating fan. The bent sections solely serve to create turbulence in order to optimize the heat exchange capabilities between the surface of the fan blade and air with which it comes into contact.

[0012] In a still further advantageous embodiment of the invention the heating means is provided by metal leads having an Ohm-resistance of approximately 40 Ω or more, where said metal leads are embedded in a thick film heat distributing lacquer layer preferably containing glass.

[0013] Although as already elaborated in the prior art and as mentioned above it is important to create turbulence adjacent the surface of the blade in order to create optimum heat exchange capabilities between the heating element and the air which is desired to be heated, it is also important to provide sufficient heating means on the surface such that a large amount of energy may be transferred from the heating element to the air. Tests indicate that a turbulent air flow across a surface increases the heat exchange by approx. 40% as compared to a laminar airflow.

[0014] Naturally, this increases the efficiency of the heating fan which is a desirable feature. Therefore, in order to provide the present invention with as large a heating surface as possible the leads are evenly distributed on the surface, and in order to further redistribute the heat the thick film layer will distribute the generated heat substantially evenly across the entire surface of the heating fan blade.

[0015] A suitable material is "insulating composition 4924" available from ESL electro-science, USA. This paste is applied in a silk-screen process in the desired layer thickness as indicated by the manufacturer. The paste comprises ultra-micro glass particles/balls which provide the special characteristics making it especially suitable for the present application.

[0016] An important aspect with the material is that the thermal characteristics substantially correspond to the base material, which typically may be stainless ferritic steel. In this manner undesired cracks in the heat distributing thick-film layer is minimised or altogether avoided, as the material is able to move with the steel during operation of the wing i.e., heating and cooling causing thermal expansion of the steel member making up the wing.

[0017] An actual wing construction used in the development of the present invention was made from stainless steel. A first layer of di-electric "insulating composition 4924" was applied. The layer was placed in an oven and the layer hardened. Thereafter an electrical lead made from a thick film silver palladium material was arranged on the surface (as illustrated in FIG. **2**), and thereafter hardened. Finally a further very thin layer of "insulating composition 4924" was placed and cured. The top layer being so thin as being substantially transparent.

[0018] Typically, the blades used with the present invention will be made from a metal, often regular steel, and as the heat is generated by means of the resistor heating element provided on the surface of the blade, the blade itself will also heat up. This heating will cause thermal expansion and by selecting the thick layer lacquer appropriately it is possible to select a lacquer which has substantially the same thermal expansion coefficient as the steel, such that a coherent surface without cracks will be provided. In this connection it is important that cracks do not occur in that this will be detrimental to the heat distribution and thereby the effective area of the blade which is able to transmit heat from the source of energy through the heating element and through the air which it is desirable to heat. Therefore, by selecting appropriate materials such that the heat is substantially evenly distributed across the entire surface of the blade and at the same time as the material from which the blade is made heats up and thereby expands the heat expansion coefficient of the thick lacquer layer shall be selected such that cracks are avoided, or at least minimized.

[0019] The surface of the blades may be provided with means such as dimples, ridges, grooves, or other unevenness in order to increase the turbulence creating capability of the blade. In this manner the heat transfer capability between the blades and the ambient air is increased.

[0020] In a further advantageous embodiment the hub comprises a collector which collector transfers electrical power from the stem/hub to at least one heating element arranged on at least one the plurality of wings, where said collector comprises a central non-conductive member, where at least a first and a second conductive member is arranged about said central non-conductive member, where non-conductive means are arranged between said first and second conductive members, and where first and second blade means are arranged for conductive contact with first and second conductive members respectively, and where said first and second blade means comprises means for a conductive connection to the heating means arranged on the wings.

[0021] Another important requirement of a heating fan is its ability to transfer energy to the heating element arranged on the blades. The present invention therefore provides a collector arranged in the hub such that as the blades rotate around the hub energy will still be transferred to the heating elements on the blades. By providing a relatively large surface between the rotating part and the stationary part it is possible to transfer relatively large amounts of energy such that the heating elements compared to prior art devices are able to reach a higher temperature and due to the turbulent conditions immediately above the heating element to transfer more energy through the air such that better heating is achieved.

[0022] The relatively large area is achieved by having the first and second blade means engaging surfaces on the first and second conductive members such that instead of a conductive member being in contact with the edge of the first conductive member as is the case in a dynamo or other stator-rotor arrangements, the blade's increased surface provides the possibility to transfer more energy.

[0023] At the same time, as the mechanical force between the blade and the first conductive member is distributed over a larger area the mechanical wear/abrasion between these two parts is much less than what is customary with normal arrangements.

[0024] In a still further advantageous embodiment the collector may be provided with any number of power transfer surfaces simply by alternating the construction such that a conductive blade member is in rotatable contact with a conductive means and that non-conductive means are interposed between the conductive arrangements. In this manner it becomes possible to provide even more energy to more blades thereby making the overall heating fan more effective.

[0025] In order to accommodate the electrical leads necessary for the transfer of energy to the blades and the resistive heating element arranged on the blade the central non-conductive member is symmetrical about a central axis, and the non conductive means are integral with the central member, and furthermore electrical leads may be arranged in the central non conductive member and brought into electrical contact with the conductive members.

DESCRIPTION OF THE DRAWING

[0026]

FIG. 1 illustrates	a ceiling mounted fan
FIG. 2 illustrates	a blade according to the invention
FIG. 3 and 4 illustrate	collectors according to the invention

DETAILED DESCRIPTION OF THE INVENTION

[0027] In FIG. **1** is illustrated a ceiling mounted fan where the fan **1** by fastening means **2** is attached to a ceiling **3**. A stem **4** connects the fastening means **2** to a hub **5**. The hub comprises motor means for rotating the blades **6** as well as collector means for distributing electrical power to the heating means arranged on the blades **6**. In this manner as the heating fan is energized the blades **6** will rotate on an axle substantially parallel to the stem such that the blades **6** will come into contact with the surrounding air and due to the energy exchange between the heating element positioned on a surface of the blade **6** heat will be transferred to the air and due to the position of the blades **6** the air will be propelled in this embodiment downwards. The downwards air movement will create under-pressure above the blades such that air will be pulled into and towards the blades. In this manner circulation of substantially all the air in a closed room may be achieved.

[0028] A critical and important aspect of the invention is the ability to transfer heat from the heating element arranged under blade **6** to the surrounding air.

[0029] In FIG. **2** is illustrated a blade according to the invention. The blade **6** comprises 3 distinct sections **10**, **11**, **12**. In this embodiment the sections **11** and **12** are arranged along trailing and leading edges **13**, **14** and are substantially identical. The surface between the sections **11**, **12** is covered by a thick film lacquer layer **15** in which is embedded a resistance heating element **16**. As energy is provided in the form of electricity to the heating element, i.e. the combined lacquered surface **15** and the heating element **16** covering substantially all of the section **10** will heat up. As the blade **6** is rotated having either the edge **13** or **14** as leading edge and the other as trailing edge air will due to the angle between the section **10** and the sections **11**, **12** pass across the surface **10** not as a laminar flow but as a turbulent flow due to the angled sections. In this manner the heat exchange between the heating element arranged on the surface **10** and the air which the blade **6** passes due to its rotation will be greatly improved such that more energy may be provided by the heating fan.

[0030] In FIG. **2** is illustrated a fan blade having a cross section with two substantially equally sized leading and trailing sections **11**, **12** respectively, but they may have different extent and also it is contemplated that only part of the edges **13**, **14** may be provided with sections **11**, **12** turned out of the plane of the remaining surface **10**.

[0031] However, the blade illustrated in FIG. **2** has proven to be extremely effective in that tests were repeatedly carried out in a room where it was desirable to elevate the temperature from approximately 6° C. to 20° C. The room has the size of approximately 4×5 metres and approximately 3 metres to the ceiling. After the temperature of 6° C. had been registered the fan was turned on. The power consumption of the heating fan was adjusted to maximum level throughout the entire period of heating and after 13-16 minutes of rotating the fan at maximum power, the room temperature had increased from 6° C. to 20° C. The heating fan used for this test had three blades arranged evenly around the perimeter of the hub where each blade was approximately 38 cm long and the first and third sections were approximately 10 mm, such that the central surface **10** on which the heating element **16** was arranged at an area of approx. 9 cm by 25 cm. The blades were made from a standard steel blade approximately 1.5 mm thick. The room temperature was measured approximately 1 meter above the floor at a location approximately 2 metres from the axis of the stem of the heating fan.

[0032] Furthermore, tests indicate that each blade as described above is able to produce approx 1000 Watts. Having three blades, the electric energy necessary to produce the maximum power will cause normal household circuitry to blow the fuses. The control electronics in the fan may therefore be programmed to only allow the blades to produce less power, or alternatively the blades shall be connected to a more powerful source of electricity.

[0033] The fans may furthermore be designed to the specific geographic conditions where they are used. For example in European Mediterranean countries the normal fuse size is 6 Amp whereas in northern Europe/Scandinavia 10 or 16 Amp fuses are used. Therefore the wattage which the fan may produce is adapted accordingly.

[0034] Another very important aspect with heating fans of this type is the ability to transfer power to the heating element. The present invention has solved this with a collector as illustrated in FIG. **3** The collector **20** comprises a first and non-conductive core member **21** which serve to isolate first and second conductive members **22**, **23**. The first and second conductive members **22**, **23** are in the shape of rings made from a metal or metal alloy, for example copper or the like.

[0035] The insulation core **21** may be made from any suitable non-conductive material such as for example plastic, ceramic or the like. The non-conductive core member is symmetric such that the conductive members **22**, **23** preferably are in the shape of rings. The non-conductive core member **21** and the rings **22**, **23** are stationary such that the first and second plate members **24**, **25** may be rotated relative to the conductive rings **22**, **23**. In this manner the surfaces facing each other of the ring members **22** and plate member **25** respectively and the ring member **23** and plate member **24** respectively provides for an electric connection between a stationary part **22**, **23** and the rotatable parts **24**, **25**. The interface surface between these conductive parts is relatively large such that substantial amounts of electricity may be transferred during rotation of the heating fan. The plate members **24**, **25** are provided with a copper layer in order to ensure electric conductivity with as little resistance as possible.

[0036] The blade members **24**, **25** are urged towards each other, for example by spring means (not illustrated).

[0037] The electricity is supplied to the ring members **22**, **23** by means of electrical leads **26**, **27** having opposite polarity.

[0038] In many domestic power installations fuses will limit the amount of electricity/power which it is possible to transmit through a single socket. In these instances the collector as illustrated in FIG. **3** will usually be sufficient in that it is not the blade **6** nor the collector which limits the amount of power available, but the domestic electrical installation.

[0039] In other instances more power is available from the installation and in these installations it may be desirable to use a three-phase electrical connection with a collector being able to transfer power from such a three-phase installation. Such a collector is illustrated with reference to FIG. **4**. The collector in FIG. **4** comprises all the elements of the collector illustrated with reference to FIG. **3** but has an additional set of conductive members **28**, **29** such that each electrical phase will have dedicated conductive members for the transfer of power from the stationary to the rotational parts.

[0040] Naturally the number of blades in any fan construction may be installed according to the individual desires. Also the type of electrical connection serial or parallel or a combination may be utilised when connecting fans within the scope of the present invention, without departing from the inventive principle.

[0041] Obviously, the collector may be expanded to include further sets of conductive and non-conductive elements depending on the number of electrical leads desirable to be providing power for the heating elements **16** provided on the blades **6**.

1. Heating fan, where said fan comprises fastening means for fastening of said fan to a first surface, a stem connecting the fastening means to a hub, where said hub comprises a motor unit, where said motor unit rotates a plurality of wings extending radially from said hub, such that the wings have an upper and a lower surface, wherein each wing has a leading and trailing edge, defining upper and lower surfaces there between where at least one wing has electrical heating means integrated or connected to said upper surface, where at least more than half the length of the leading and/or trailing edge is bent relative to the surface of the wing.

2. Heating fan according to claim **1** wherein the wing profile in a cross section perpendicular to the radial extent of the wing relative to the hub, comprises three distinct substantially linear sections, a first linear section extending between 5 to 25 mm from the leading edge and a second linear section extending between 5 to 25 mm from the trailing edge, and a third linear section arranged between the first and second sections, where said third linear section has an extent between 35 and 110 mm, where the first and second linear sections are angled 5° to 60° relative to the third section.

3. Heating fan according to claim **1** wherein the heating means is provided by metal leads having an Ohm-resistance of approximately 40 Ω or more, where said metal leads are embedded in a thick heat distributing film layer preferably a dielectric composition having a layer thickness of 50 micrometers or more.

4. Heating fan according to claim **3** wherein the heating means is selected from the group of materials having positive temperature coefficient.

5. Heating fan according to claim **1** wherein the hub comprises a collector which collector transfers electrical power from the stem/hub to at least one heating element arranged on at least one of the plurality of wings, where said collector comprises a central non-conductive member, where at least a first and a second conductive member is arranged about said central non-conductive member, where non-conductive means are arranged between said first and second conductive members, and where first and second blade means are arranged for conductive contact with first and second conductive members respectively, and where said first and second blade means comprises means for a conductive connection to the heating means arranged on the wings.

6. Heating fan according to claim **5** wherein the first and second conductive members are ring shaped, having a conductive surface in the radial direction, and where the first and second blade means are biased towards contact with the conductive surfaces of the first and second conductive members respectively.

7. Heating fan according to claim **1** wherein the hub comprises a collector which collector transfers electrical power from the stem/hub to the at least one heating element arranged on at least one of the plurality of wings, where said collector comprises a central non-conductive member, n conductive members are arranged about said central non-conductive member, where non-conductive means are arranged between said n conductive members, and where n conductive blade means are arranged for conductive contact with the n conductive members, such that one conductive member is in conductive contact with one conductive blade member, and where said blade means comprises means for a conductive connection to the heating means arranged on the wings, where n is a number between 2 and 9, preferably 3.

8. Heating fan according to claim **5** wherein the central non conductive member is symmetrical about a central axis, and that the non conductive means are integral with the central member, and furthermore that electrical leads may be arranged in the central non conductive member, and brought into electrical contact with the conductive members.

9. Heating fan according to claim **1** wherein further means for increasing the roughness of the blades' surface, thereby creating more turbulence, is provided on the blades' surface.

10. Blade for use in a heating fan according to claim **1** wherein the blade has a front and rear face, two side edges, an inner edge and an outer edge, where the inner edge is suitable to be mounted to a hub of a fan, where the blade is made from a ferrite material, and that an electrical conductive resistive lead is arranged on the front face, said lead having electrical connection means, and that furthermore a dielectric layer of at least 50 micrometers is arranged on said front face covering a substantial part of said front face, and that along the side edges the faces are bent out of the general plane of the faces.

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