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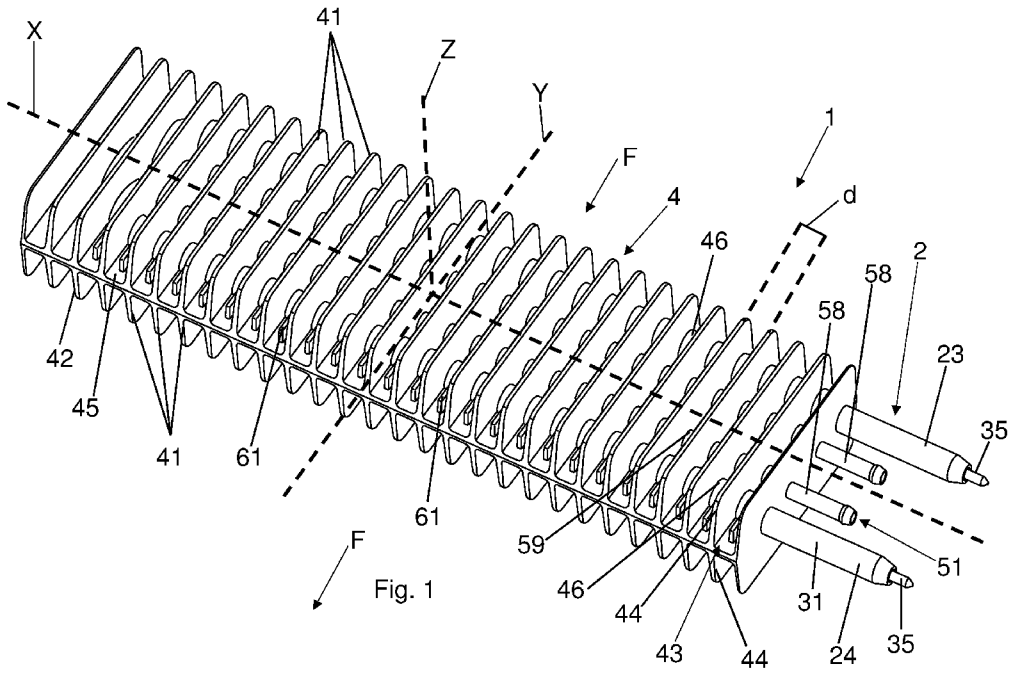

Fig. 1

(57) Abstract: An electric heater (1) for heating an air flow in a household appliance, in particular a laundry dryer appliance, the electric heater (1) comprising: at least one heating element (2) adapted to be connected to an electric energy source to generate heat, a body (4) made of thermally conductive material provided with a plurality of fins (41), in which said at least one heating element (2) is arranged; wherein said at least one heating element (2) is in contact with the body (4), whereby the heat generated by the at least one heating element (2) can be transferred to the body (4), which is adapted to heat said air flow; a tube (51) for the water to pass, at least partially arranged in the body (4), whereby the heat generated by the at least one heating element (2) can be transmitted to the tube (51) through the body (4).

[Continued on next page]

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“ELECTRIC HEATER FOR HOUSEHOLD APPLIANCE”

Field of the invention

The present invention relates to an electric heater for heating an air flow in a household appliance, in particular a laundry dryer appliance. The invention also relates to a household appliance, in particular a laundry dryer, configured to operate with a flammable gas, such as propane, for example. The invention also relates to a process for manufacturing such an electric heater.

Background art

The heat pumps used in certain household appliances use flammable gases as an operating fluid, in particular as a cooling fluid. Propane (R290) is an example of flammable gas used in such heat pumps.

The use of flammable gases is increasing for ecological reasons. Thus, many heat pumps which to date use non-flammable gases as cooling fluids will be redesigned in the future to operate with flammable gases, in particular with more ecological flammable gases.

A critical aspect of heat pumps operating with such gases is given precisely by the flammable nature of this type of gas.

In order to avoid flammable gas fire hazards, regulations typically prescribe that no surface which can come into contact with the flammable gas - also upon an accidental leak - exceeds given safety temperatures in the apparatuses using them. Certain household appliances, such as heat pump laundry dryers, for example, currently use types of heaters which do not meet the above requirement.

For example, certain household laundry dryer appliances use “bare wire” type heaters, which provide a bare wire adapted to come into direct contact with the air to be heated.

In general, bare-wire heaters are used to carry out quick cycles in certain heat pump laundry dryers to quickly heat the air which serves for the drying cycle.

However, it is particularly difficult to achieve a precise control of the heating temperature in bare-wire heaters. In particular, it cannot be ensured that the heating surface does not exceed the safety temperature limit.

The need is therefore felt for a technical solution which can ensure the safety

temperatures are not exceeded, in particular in household appliances which heat pump operates with flammable gases.

Summary of the invention

It is an object of the present invention to provide an electric heater for heating an air flow in a household appliance, which also allows heating water, in particular for generating steam.

It is another object of the invention to provide such an electric heater which heating temperature, in particular the temperature of the outer surfaces of the electric heater, can be controlled in a particularly accurate manner.

It is another object of the present invention to provide such an electric heater which allows an optimal transmission of heat to the air flow.

It is another object of the present invention to provide such an electric heater which can be manufactured in an easy and affordable manner.

The present invention achieves at least one of such objects and others which will become apparent from the present description, by means of an electric heater for heating an air flow in a household appliance, in particular a laundry dryer appliance, the electric heater comprising: at least one heating element adapted to be connected to an electric energy source to generate heat; a body made of thermally conductive material provided with a plurality of fins, in which said at least one heating element is arranged; wherein said at least one heating element is in contact with said body, whereby the heat generated by the at least one heating element can be transferred to the body, which is adapted to heat said air flow; the electric heater also comprising a tube for the water to pass, at least partially arranged in the body, whereby the heat generated by the at least one heating element can be transmitted to the tube through the body.

In particular, the at least one heating element is at least partially arranged in said body.

The tube also is in contact with said body, whereby the heat generated by the at least one heating element can be transferred to the tube through the body. The tube in turn is adapted to heat the water crossing it. One tube only can be provided, or more than one tube can be provided for the passage of the water, for example two tubes.

According to one aspect, the invention also comprises a household appliance, in particular according to claim 13.

According to a further aspect, the invention comprises a process, preferably a die casting process, in particular according to claim 15, wherein there are provided a mold for manufacturing said body and means for injecting melted material, the process comprising the steps of: a) arranging said at least one heating element and said tube in the mold; b) injecting melted material into the mold.

In addition to an effective and safe heating of the air flow, the electric heater advantageously also allows a flow of water crossing the tube to be effectively heated. The water can be heated for example, so that it can pass from the liquid state to the vapor state.

The electric heater according to the invention advantageously allows accurately controlling the heating temperature thereof.

In particular, the electric heater allows a predetermined temperature limit of the outer surfaces thereof not to be exceeded, which surfaces could accidentally come into contact with the flammable gas, e.g. propane, used by the heat pump of the household appliance in which the electric heater is assembled.

By arranging the at least one heating element in the body provided with fins, good control of the temperature of such a body can advantageously be obtained.

One or more fuses, in particular one or more thermal cut-off fuses, can be integrated in the heating element to ensure the aforesaid temperature limit is not exceeded.

Moreover, an optimal transmission of the heat, and therefore an optimal heating of the air flow to be heated, is advantageously obtained by providing the finned body, i.e. provided with fins.

The electric heater is also particularly adapted to quickly heat the air which serves for the drying cycle or step.

The air can advantageously be conveniently heated by means of the electric heater of the invention also during the first step of the drying cycle of a heat pump household appliance, also if the heat pump is not yet at thermal regime during such a first step.

Further features and advantages of the invention will become more apparent in light of the detailed description of non-limiting embodiments.

The dependent claims describe particular embodiments of the invention.

Brief description of the drawings

In the description of the invention, reference is made to the accompanying drawings, which are provided by way of a non-limiting example, in which:

Fig. 1 shows a perspective view of an electric heater according to the invention;

Fig. 2 shows a part of the heater in Fig. 1, cross-sectioned along plane X-Y;

Fig. 3 diagrammatically shows a part of a component of the heater in Fig. 1;

Fig. 4 shows an enlarged detail of Fig. 2;

Fig. 5 shows a perspective view of an electric heater according to the invention, in which a component (in particular, the tube) and the related seat are not depicted for illustrative purposes.

The same references in the drawings identify the same elements or components, or functionally equivalent elements or components.

Detailed description of embodiments of the invention

With reference to the figures, an electric heater 1 for heating an air flow in a household appliance, in particular a laundry dryer appliance, is described.

The electric heater 1 is described with reference to a set of three axes, X, Y, Z which are perpendicular to one another and are incident in one point. Preferably, axis X is a longitudinal axis of the electric heater 1, for example a longitudinal central axis.

In all the embodiments, the electric heater 1 comprises:

- at least one heating element 2 adapted to be connected to an electric energy source (not shown) to generate heat;
- a body 4 made of thermally conductive material provided with a plurality of fins 41, in which said at least one heating element 2 is arranged;
- a tube 51 for the water to pass, at least partially arranged in body 4, whereby the heat generated by the at least one heating element 2 can be transmitted to the tube 51 through body 4.

The heating element 2 is in contact with the body 4, whereby the heat that is generated can be transferred to body 4, in particular by conduction. Body 4 in turn is adapted to heat the air flow. In particular, the body 4 can transfer the heat by convection.

The electric heater 1 is preferably designed so that body 4, in particular the outer

surface thereof, can reach a maximum temperature of 370 °C, preferably a maximum temperature of 350 °C or 300 °C.

One heating element 2 only is preferably provided, although several heating elements 2 can also be provided.

Preferably, the at least one heating element 2 is a sheathed resistor 2. In particular, the sheathed resistor 2 comprises a casing 31 in which at least one resistive element 32 is arranged (Figures 2 and 4), e.g. a resistive wire 32, for example a resistive wire 32 wound around an axis of the heating element 2.

Casing 31, which is preferably tubular, is made of thermally conductive material, preferably made of metal, such as steel, for example. Preferably, casing 31 is in direct contact with body 4.

The resistive wire 32 is preferably surrounded by or immersed in an electrically insulating material, e.g. magnesium oxide. The ends, or end portions, of the resistive wire 32 are preferably connected to a respective electrically conductive pin 33 (Fig. 4).

The heating element 2 is provided with end portions 23, 24, preferably two end portions, for the connection to the electric energy source. When the heating element 2, and more specifically the resistive element 32, is crossed by electric current, it generates heat due to the Joule effect.

The heating element 2 is preferably provided with at least one fuse 21, 22 (Figures 2 and 4), in particular at least one thermal cut-off fuse, integrated therein.

The at least one fuse 21, 22 is preferably configured to open at a temperature between 140 °C and 240 °C, preferably between 160 °C and 216 °C.

So, by opening, fuse 21, 22 interrupts the passage of electric current in the heating element 2, and therefore body 4 is prevented from reaching temperatures which are too high.

The at least one fuse 21, 22 is preferably integrated in one of the end portions 23, 24.

Two fuses 21, 22 are preferably provided, of which each fuse 21, 22 is preferably integrated in a respective end portion 23, 24 of the heating element 2.

Preferably, for each end portion 23, 24, the respective fuse 21, 22 is electrically connected to pin 33 and to a further pin 35. In particular, the respective fuse 21, 22

is connected to pin 33 and to the further pin 35, given that it is arranged between such pins 33, 35. The pins 35 project from casing 31 of the heating element 2 so that can be connected to the electric energy source. In particular, the pins 35 cross a respective closing element 36 which closes, in particular seals, casing 31.

Alternatively in a variant not shown, there can be provided a single pin instead of the two pins 33, 35, which single pin is connected to a respective end (or end portion) of the resistive wire 32 and which projects from the respective end portion 23, 24. In this variant, a fuse integrated with one of such pins can be provided, or two fuses can be provided, each one of which being integrated with a respective pin.

The heating element 2 preferably comprises two substantially, preferably parallel, straight stretches 25, 26 (Fig. 2). In particular, it is preferable that the straight stretches 25, 26 define a respective axis, preferably a longitudinal axis, which is parallel to axis X. Each straight stretch 25, 26 comprises a respective end portion 23, 24. Alternatively, the end portions can be transverse with respect to the straight stretches 25, 26.

The straight stretches 25, 26 are preferably joined to each other by a curved stretch 27.

Preferably, the heating element 2 is substantially “U”-shaped, substantially formed by the two straight stretches 25, 26 and by the curved stretches 27. In particular, it is preferable that the “U”-shaped axis defined by the heating element 2 lies completely on a same plane.

Preferably, the heating element 2 is off-center with respect to axis X, which preferably is the central and preferably the longitudinal axis both of body 4 and of the electric heater 1.

For example, the longitudinal axis of the straight stretch 26 is at a greater distance from the aforesaid axis X with respect to the distance between the longitudinal axis of the straight stretch 25 and the aforesaid axis X, such distances in particular being the minimum distances, i.e. measured along axis Y. In other words, preferably, parallel to axis Y, the distance between stretch 26 and the peripheral edge of body 4 proximal to stretch 26 is less than the distance between stretch 25 and the opposite peripheral edge of body 4, proximal to stretch 25.

Preferably, the heating element 2 has an overall length, for example along such a

"U"-shaped axis, between 200 mm and 800 mm.

Preferably, the end portions 23, 24 each have a length between 20 mm and 70 mm.

Other shapes and/or dimensions of the heating element 2 can also be provided.

As already mentioned, the heating element 2 is arranged in body 4.

The heating element 2 is preferably arranged in body 4 so that the two end portions 23, 24 project from body 4. In particular, it is preferable that the whole heating element 2 is be arranged in body 4, with the exception of the end portions 23, 24. Alternatively, the whole heating element 2 can be arranged in body 4, with the exception of the pins 35 (or of the single pin provided for each end of the resistive element 32 in the case of the variant described above). When provided, the at least one fuse 21, 22 can be arranged inside or outside body 4.

Body 4 is made of thermally conductive material, preferably made of metal such as for example, aluminum or aluminum alloys, or zinc alloys, such as Zama alloy. Alternatively, body 4 can be made of thermally conductive plastic, for example polyamide containing graphite.

Preferably, each fin 41 has a width, parallel to axis Y, and a height, parallel to axis Z, which are greater than the thickness, parallel to axis X. Preferably, the width of each fin 41 is greater than the height thereof.

Preferably, the fins 41 all have the same width, the same height and the same thickness.

Preferably, each fin 41 has a height between 15 mm and 80 mm.

The height of each fin 41 preferably corresponds to the overall height of the electric heater 1.

Preferably, each fin 41 has a width between 40 mm and 150 mm.

The width of each fin 41 preferably corresponds to the overall width of the electric heater 1.

Preferably, the overall length of the electric heater 1 is between 100 mm and 350 mm.

Preferably, the fins 41 are parallel, or substantially parallel, to one another. In particular, the planes defined by the width and height of each fin 41 are parallel to one another, and preferably are parallel to plane Y-Z.

The fins 41 are preferably spaced apart from one another along axis X by a distance

"d" (Fig. 1) between 2 mm and 20 mm. In particular, such a distance "d" corresponds to the minimum distance between two mutually facing faces of two consecutive fins 41.

Preferably, the fins 41 are equally spaced apart, for example the distance between each pair of consecutive fins 41 is equal to or about equal to said distance "d".

The outer profile (or outer surface) of body 4 preferably comprises a plurality of portions 46, or ribs, which substantially trace the outer profile of the heating element 2, in particular of the casing 31 thereof. In greater detail, the portions 46 are preferably curved, outwardly convex. Preferably, the outer surface of such curved portions 46 is substantially a cylindrical portion of side surface. The curvature center of such outer surfaces is inside the body 4.

Preferably, the number of fins 41 is between 5 and 50. By mere way of example, there can be provided twenty-eight fins 41, as shown by way of example in Fig. 1.

At least a part of the fins 41, or also all the fins 41, are alternated by, i.e. alternated with, the aforesaid curved portions 46, in particular parallel to axis X. The fins 41 preferably comprise, or consist of, two lamellar portions 44 which extend in opposite directions from each other, from a basal portion 43 which is part of body 4. Preferably, such a basal portion 43 is substantially central with respect to the aforesaid two lamellar portions 44.

Preferably, the basal portion 43 comprises preferably flat or substantially flat portions 45 and the aforesaid curved portions 46 and preferably the curved portions 59 which are described later.

In particular, a flat portion 45 is preferably provided between pairs of fins 41.

Preferably, there are two curved portions 46 and two curved portions 59 between some pairs of fins 41, along a direction parallel to axis Y.

For some flat portions 45, a part 45'' of the flat portion 45 (Fig. 5) is preferably provided, which extends between two curved portions 46, and a respective part 45', 45'' of the flat portion 45 preferably extends outwardly on the opposite side of each curved portion 46. Preferably, the flat portion 45' has an extension parallel to axis Y which is shorter than the extension of the flat portion 45''. In other words, more generally, as already mentioned, the heating element 2 preferably is off-center with respect to longitudinal central axis X of body 4, such axis X substantially coinciding

with the longitudinal central axis of the electric heater 1.

The aforesaid decentering of the heating element 2 advantageously allows the fins 41 to be kept at the same temperature as much as possible, i.e. isothermal, along axis Y, which is preferably parallel or substantially parallel to the direction of the air flow to be heated, said direction of the flow being diagrammatically indicated in Figures 1 and 2 by means of the arrows F. In particular, it is preferable to arrange the electric heater 1 so that the air flow to be heated first laps the part comprising the stretch 26 and then the part comprising the stretch 25.

Note that, more generally, the heating element 2 can be arranged in off-center position with respect to the longitudinal central axis X of body 4 (which substantially coincides with the longitudinal central axis of the electric heater 1), irrespective of the above-described specific shape of body 4, in particular irrespective of the presence of the flat portions 45', 45'', 45''' and of the curved portions 46.

The curved portions 46 are preferably raised with respect to the flat portions 45. Preferably, the curved portions 46 have a maximum height, parallel to axis Z, which is less than the height, or maximum height, of the fins 41. The curved portions 46 preferably extend from both the opposite faces of the basal portion 43, of which only one is shown in Fig. 1.

The peripheral or perimetral edge 42, i.e. the periphery, of at least some fins of the plurality of fins 41, or also of all the fins 41, preferably extends around the heating element 2, in particular around axis X.

Preferably, the peripheral edge 42 is substantially defined by a quadrilateral, e.g. a rectangle, preferably with rounded corners.

The heating element 2 is preferably arranged at about half the height of the fins 41.

As already mentioned, a tube 51 destined to be crossed by a flow of water is also advantageously arranged in the body 4. In particular, the tube 51 serves the function of steam generator because water in the liquid state can be heated by the heating element 2 through body 4 so as to generate steam. The tube has an inlet opening and an outlet opening for the inlet and outlet of the water. Tube 51 comprises two end portions 58 which preferably are outside the body 4, while the remaining part of tube 51 is inside body 4. In particular, with the exception of the end portions 58, the outer surface of tube 51 preferably is in contact, preferably directly in contact, with

body 4.

Preferably, tube 51 has at least one stretch parallel to the heating element 2.

Tube 51 and the heating element 2 can also be completely parallel to each other.

Preferably, tube 51 is "U"-shaped, like the heating element 2. In particular, it is preferable that the two straight stretches 55, 56 (Fig. 2) of the tube 51 are parallel to a respective straight stretch 25, 26 of the heating element 2, and that the curved stretch 57 of tube 51 is parallel to the curved stretch 27 of the heating element 2.

Alternatively, the tube and the heating element have a different shape or geometry from each other.

Tube 51 and the heating element 2 preferably lie on the same plane. In particular, the tube 51 and the heating element 2 define a respective axis (which is "U"-shaped in the examples shown), and preferably the axis of tube 51 and the axis of the heating element 2 are coplanar, for example they both lie on plane X-Y.

Tube 51 is preferably arranged more inward with respect to the heating element 2.

The wall of tube 51 is preferably corrugated. Fig. 3 shows by way of example, the outer wall of a portion of tube 51 when it is corrugated. Such a wall can for example, comprise portions 52 and portions 53, the latter having a smaller outer diameter than the outer diameter of portions 52. Portions 52 alternate with portions 53. By providing the corrugated wall of tube 51, the heat exchange is improved between body 4 and tube 51, and therefore the heating of the water flowing in tube 51 is optimized.

Tube 51 is preferably made of metal, e.g. steel.

Body 4 preferably comprises curved portions 59, or ribs, similar to the curved portions 46, also at tube 51.

Further fins 61 are optionally provided in all embodiments between all or only some of the fins 41 (Fig. 1).

Preferably, the fins 61 have a shorter height, parallel to axis Z, than the fins 41. In particular, the fins 61 are lowered with respect to fins 41. Two or more fins 61 spaced apart from one another, in particular parallel to axis Y, are preferably provided between two fins 41, although one fin 61 only can also be provided between two fins 41. Preferably, the fins 61 are in contact with a respective curved portion 46.

As shown in Fig. 5 (in which tube 51 and the related seat are not depicted for the

purposes of illustration), fin 61 preferably extends parallel to axis Y from both sides of the curved portion 46 for each of the curved portions 46 at stretch 25 (proximal to axis X).

Fin 61 preferably extends parallel to axis Y only on one side of the curved portion 46, preferably towards axis X, for each of the curved portions 46 at stretch 26 (distal from axis X).

The fins 61 can be provided at stretch 25 and/or at stretch 26.

The fins 61 can extend from one or both the opposite faces of the basal portion 43.

The fins 61 advantageously allow the heat exchange to be increased with the air flow to be heated.

According to one aspect, the invention comprises a household appliance provided with ventilation means for generating an air flow, and at least one electric heater 1, for example only one electric 1, adapted to heat such an air flow. Preferably, the household appliance is a laundry dryer or a washer-dryer, and the air flow is directed towards the laundry dryer drum to carry out a drying cycle or step of the garments contained in the drum.

The steam exiting from tube 51 advantageously can be directed towards the drum of the household appliance.

The household appliance preferably comprises a heat pump configured to operate with a flammable gas, e.g. propane.

As already mentioned, the electric heater 1 is preferably arranged so that the width of the fins 41, parallel to axis Y, is substantially or mainly parallel to direction F of the air flow.

A conduit for conveying the air flow generated by the ventilation means is preferably provided, inside of which at least the body 4 of the electric heater 1 is arranged transversely, so that said air flow generated by the ventilation means hits the body 4 first at a stretch 26 of the heating element 2, which is distal from said central axis, and then at a stretch 25 of the heating element 2, which is proximal to said central axis.

In a process for manufacturing an electric heater 1, preferably there are provided:

- a mold for manufacturing body 4; and
- means for injecting melted material.

The process comprises the steps of:

a) arranging the at least one heating element 2 and the tube 51 in the mold;

b) injecting melted material into the mold.

Preferably, the melted material is a metal, for example aluminum or comprising aluminum, or a zinc alloy, such as Zama alloy.

Preferably, the process is a die casting process.

When at least one fuse 21, 22 is provided, in particular at least one thermal cut-off fuse, it can be integrated in the heating element 2 after step b), or prior to step a).

By mere way of example, in the first case, the heating element 2 is arranged in the mold in step a) so that at least one end portion 23, 24, preferably both end portions, of the heating element 2 preferably is/are outside the mold.

Fuse 21, 22 is integrated in the end portion 23, 24 after step b).

When two fuses 21, 22 are provided, each fuse 21, 22 is integrated in a respective end portion 23, 24.

In the second case, i.e. when the fuse is integrated in the heating element 2 prior to step a), it is preferable to have cooling means for cooling the area of the heating element 2 at the at least one fuse 21, 22 so as not to compromise the fuse(s), i.e. so as not to cause the opening thereof.

When for example, the at least one fuse 21, 22 is arranged inside body 4, the cooling means are particularly adapted to cool the areas of the mold in contact with the walls of the heating element 2 which contain the thermal cut-off fuse, or the thermal cut-off fuses.

When for example, the at least one thermal cut-off fuse 21, 22 is arranged in an end portion 23, 24 that is to be outside body 4, the heating element 2 is arranged in the mold in step a) so that at least one end portion 23, 24 of the at least one heating element 2 is outside the mold;

and the at least one fuse 21, 22 is integrated in an end portion 23, 24 prior to step a). Two fuses 21, 22 as described above can be provided also in this case.

During step b), the end portion, or the end portions, provided with the fuse(s) preferably is/are cooled by means of cooling means.

CLAIMS

1. An electric heater (1) for heating an air flow in a household appliance, in particular a laundry dryer appliance,

the electric heater (1) comprising

- at least one heating element (2) adapted to be connected to an electric energy source to generate heat;
- a body (4) made of thermally conductive material provided with a plurality of fins (41), in which said at least one heating element (2) is arranged;

wherein said at least one heating element (2) is in contact with said body (4), whereby the heat generated by the at least one heating element (2) can be transferred to the body (4), which is adapted to heat said air flow;

- a tube (51) for the water to pass, at least partially arranged in the body (4), whereby the heat generated by the at least one heating element (2) can be transmitted to the tube (51) through the body (4).

2. An electric heater (1) according to claim 1, wherein said at least one heating element (2) is provided with at least one fuse (21, 22) integrated therein.

3. An electric heater (1) according to claim 2, wherein said at least one heating element (2) is provided with end portions (23, 24) outside the body (4), for the connection to the electric energy source, and wherein said at least one fuse (21, 22) is integrated in one of said end portions (23, 24).

4. An electric heater (1) according to claim 3, comprising at least two fuses (21, 22), and wherein each fuse (21, 22) is integrated in a respective end portion of said end portions (23, 24).

5. An electric heater (1) according to any one of the preceding claims, wherein the at least one heating element (2) is off-center with respect to a central axis, preferably a longitudinal central axis, of the body (4).

6. An electric heater (1) according to any one of the preceding claims, comprising further fins (61) arranged between at least some of the fins (41); wherein said further fins (61) are arranged at a first stretch (26) of the heating element (2) which is distal from a central axis of the body (4) and/or at a second stretch (25) of the heating element (2) which is proximal to said central axis.

7. An electric heater (1) according to any one of the preceding claims, wherein said

fins (41) are substantially parallel to one another and/or wherein said fins (41) are equally spaced apart from one another and/or said fins (41) are spaced apart from one another along an axis (X) by a distance (d) between 2 mm and 20 mm.

8. An electric heater (1) according to any one of the preceding claims, wherein said at least one heating element (2) is a sheathed resistor; and/or wherein said at least one heating element (2) comprises two stretches (25, 26), preferably straight and/or parallel to each other, joined by a curved stretch (27).

9. An electric heater (1) according to claim 8, wherein said fins (41) are transverse to said two stretches (25, 26), preferably perpendicular to said two stretches (25, 26).

10. An electric heater (1) according to any one of the preceding claims, wherein the peripheral edge (42) of at least some fins (41) of said plurality of fins (41) extends around said at least one heating element (2).

11. An electric heater (1) according to any one of the preceding claims, wherein the tube (51) has a corrugated outer wall.

12. An electric heater (1) according to any one of the preceding claims, wherein the tube (51) comprises at least one stretch parallel to the at least one heating element (2); or wherein the tube (51) and the at least one heating element (2) are completely parallel to each other.

13. A household appliance comprising ventilation means for generating an air flow, and at least one electric heater (1) according to any one of the preceding claims, for heating said air flow, preferably wherein the household appliance comprises a heat pump configured to operate with a flammable gas, preferably propane, said household appliance preferably being a laundry dryer or a washer-dryer.

14. A household appliance according to claim 13, wherein the at least one heating element (2) is off-center with respect to a central axis, preferably a longitudinal central axis of the body (4), and preferably wherein the electric heater (1) is arranged so that said air flow generated by the ventilation means hits the body (4) first at a first stretch (26) of the heating element (2) which is distal from said central axis, and then at a second stretch (25) of the heating element (2) which is proximal to said central axis.

15. A process for manufacturing an electric heater (1) according to any one of claims

1 to 12, wherein there are provided:

- a mold for manufacturing said body (4);
- means for injecting melted material;

the process comprising the steps of:

a) arranging said at least one heating element (2) and said tube (51) in the mold;

b) injecting melted material into the mold by means of the injection means,

preferably wherein at least one fuse (21, 22) is provided;

and wherein said at least one fuse (21, 22) is integrated in the heating element (2) after step b), or prior to step a),

and preferably wherein, when said at least one fuse (21, 22) is integrated in the heating element (2) prior to step a), the area of the heating element (2) at the at least one fuse (21, 22) is cooled off by means of cooling means.

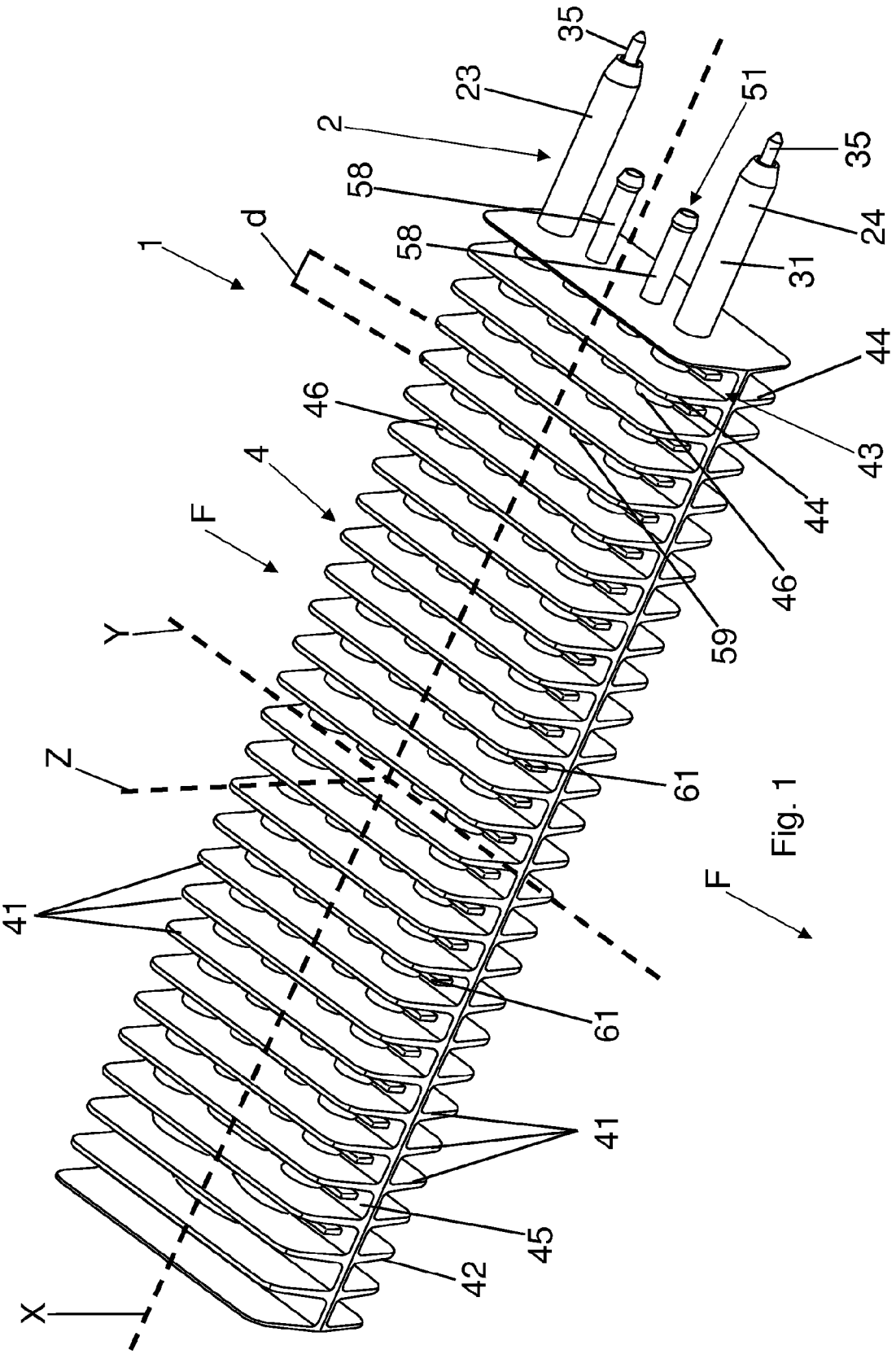

Fig. 1

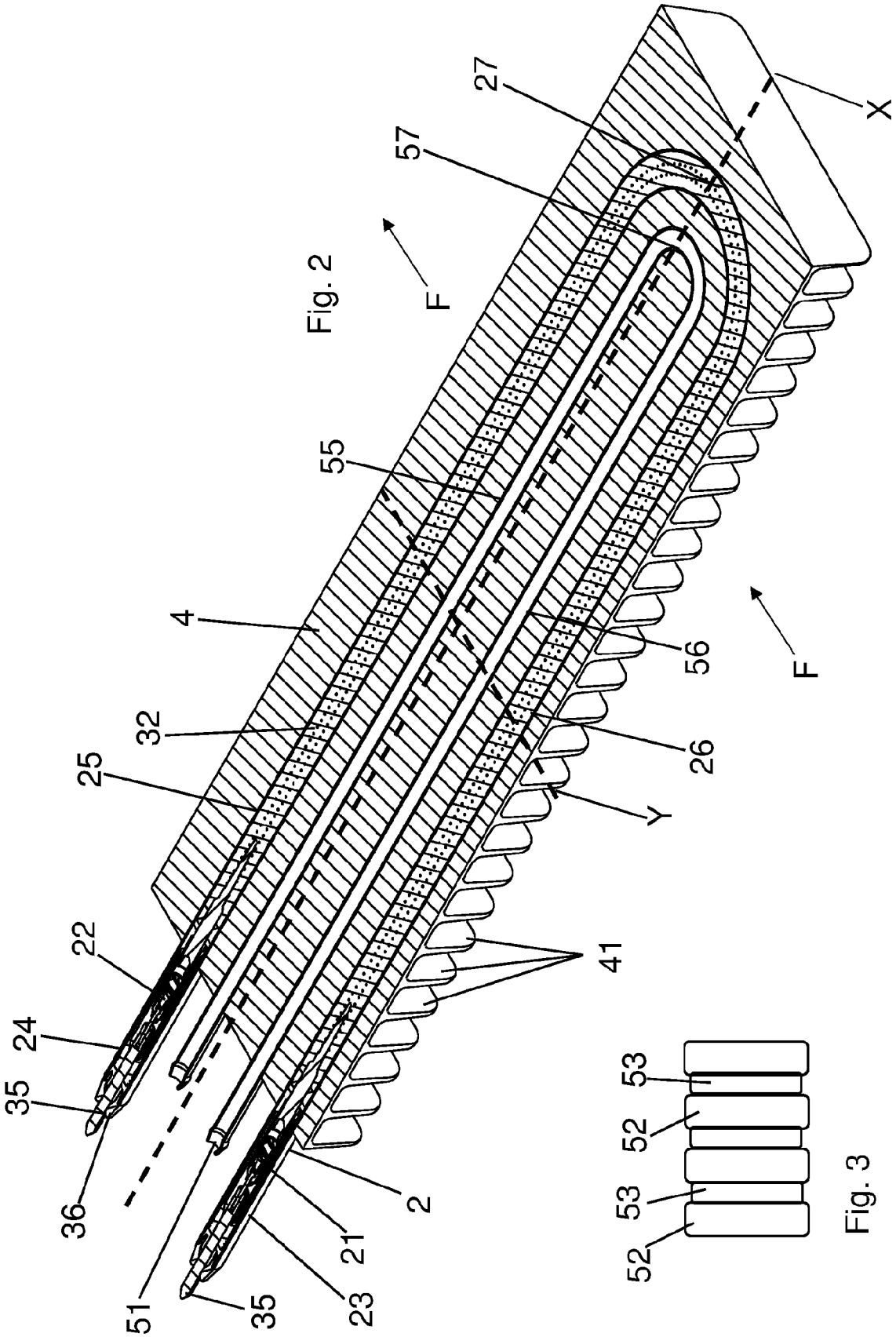

Fig. 2

Fig. 3

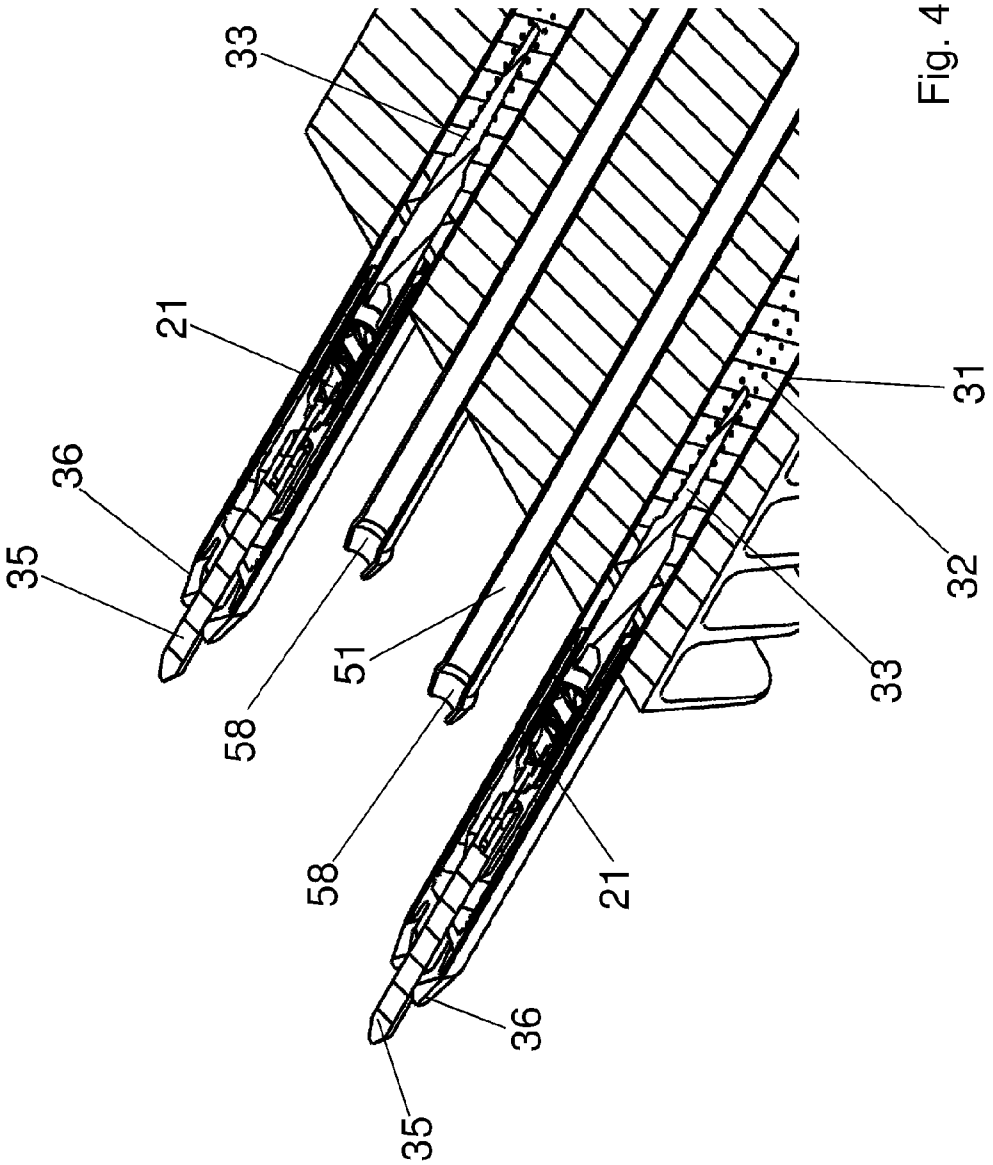

Fig. 4

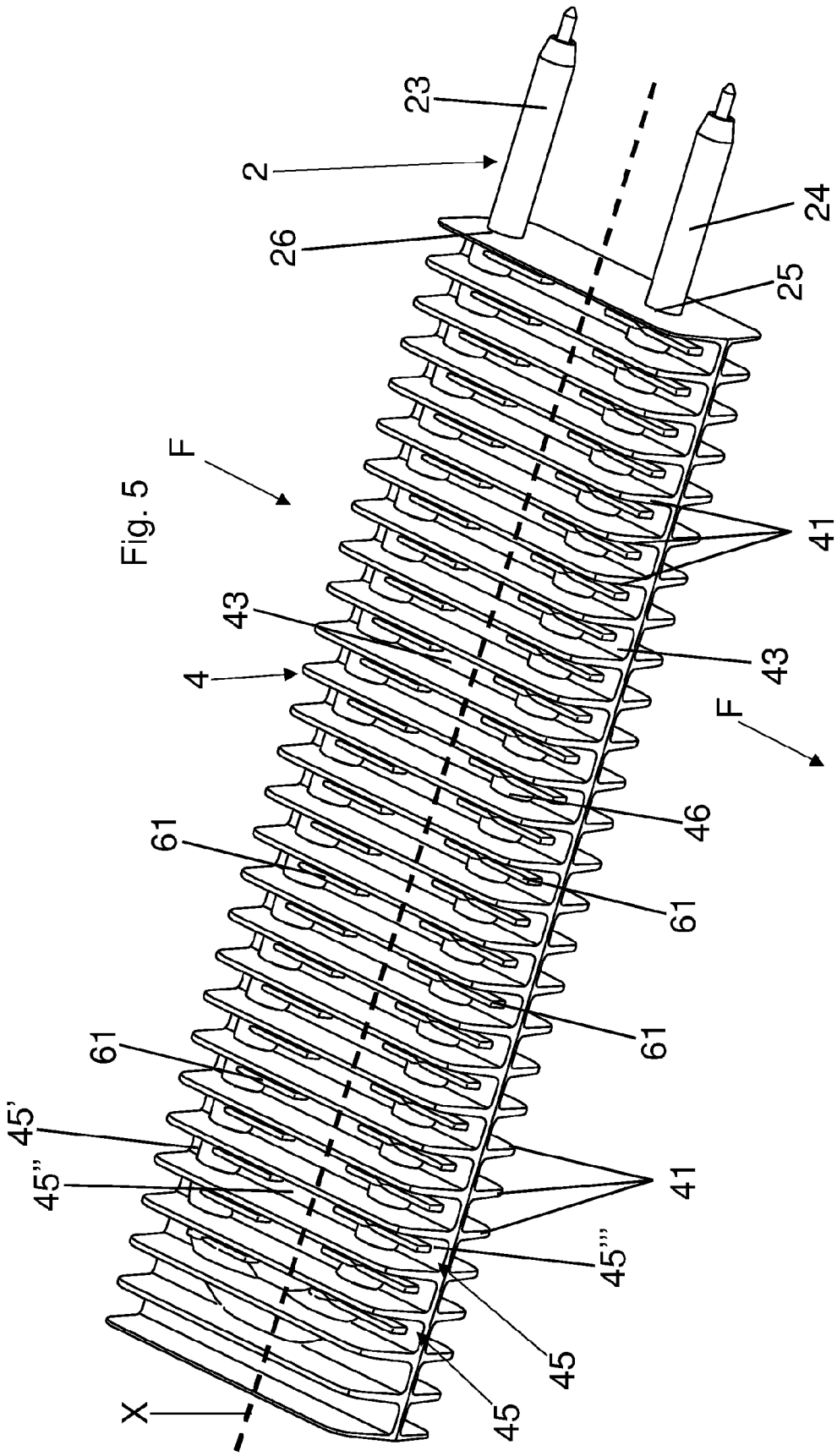

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/059797

A. CLASSIFICATION OF SUBJECT MATTER
INV. D06F58/26 F24H3/00
ADD. F24H3/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D06F F24H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 33 40 313 A1 (LICENTIA GMBH [DE]) 15 May 1985 (1985-05-15)	1,5,7-10
A	page 3, line 20 - page 4, line 5 page 4, line 33 - page 5, line 10; figure 1 page 5, line 12 - page 6, line 18; figures 2, 3	2-4,6

A	EP 0 320 966 A1 (IRCA SPA [IT]) 21 June 1989 (1989-06-21) column 2, line 40 - column 3, line 42; figures 1-5	1-5, 7-11,15

A	WO 2011/029826 A2 (MUNSTER SIMMS ENG LTD [GB]; RAGG CHRISTOPHER WILLIAM [GB]) 17 March 2011 (2011-03-17) page 3, line 29 - page 4, line 35; figures 1, 2	1-15

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 January 2020	28/01/2020

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/059797

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2016/273801 A1 (KAPILA NIVEDITA [US] ET AL) 22 September 2016 (2016-09-22) paragraph [0014] - paragraph [0019] paragraph [0022] - paragraph [0026] paragraph [0036] - paragraph [0040]; figures 1-3 paragraph [0043] -----	1,5,7-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2019/059797

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EP 0320966 A1	21-06-1989	NONE	
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		EP 2462385 A2	13-06-2012
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		WO 2011029826 A2	17-03-2011
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