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(54) Electrical resistor for heating equipment

(57) An electrical resistor for heating apparatus comprises a least one resistance wire that is shaped according to at least one wave form and defines coils fitted along an extension axis, and at least one insulating support adapted tc carry the coils and extending along the extension axis; the electrical resistor is of such a nature that the wave form defines a varying undulation density.

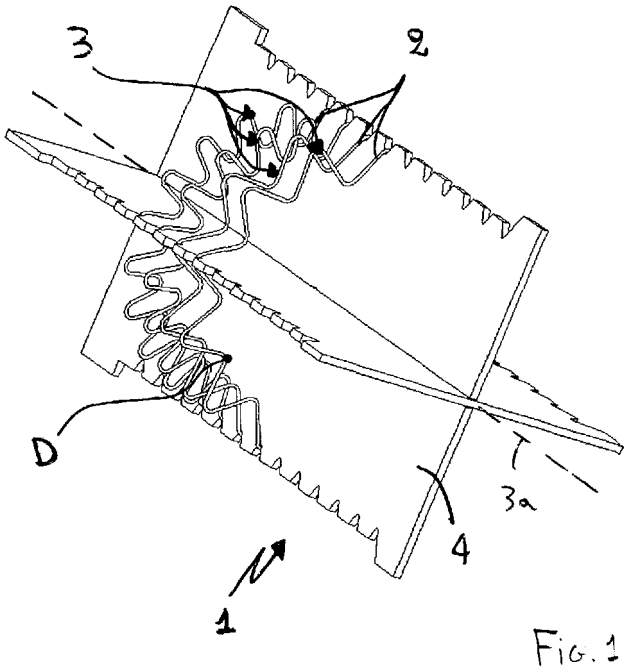

Fig. 1

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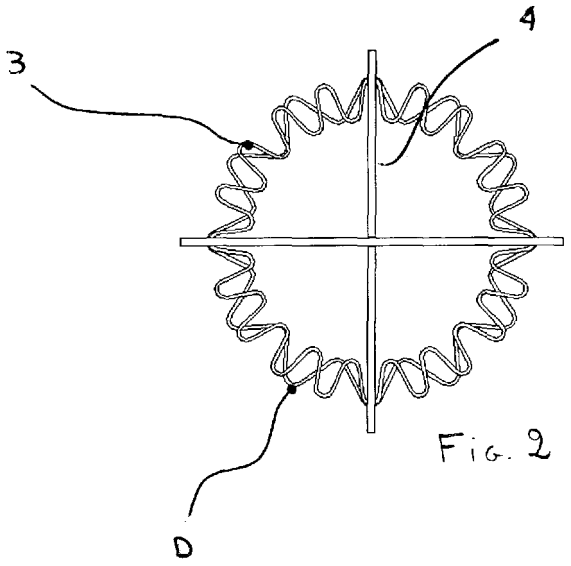

Fig. 2

Description

[0001] The present invention relates to an electrical resistor (also referred to as "heating element") to be used in hairdriers and similar equipment, the main function of which is to heat an air mass.

[0002] It is known that currently electrical resistors used in hairdryers are made of one or more wave-shaped resistance wires which are wound up into aligned coils on an insulating support.

[0003] Generally, as regards conformation of the wave and density of the undulations (i.e. in terms of number of waves per unit length), in the electrical resistors of known type the number of waves per coil appears to be constant along the whole winding and/or also constant appears to be the number of waves for each coil sector.

[0004] While the described known art has been adopted for many years and with many improving variations, it however still has some drawbacks.

[0005] In fact, this structure of known type of construction (with a constant density of the undulations) does not enable distribution of the thermal power transferred to the air on the body of the heating element (or resistor) to be controlled.

[0006] In addition, during operation of the heating apparatus the air flow impinges on the resistor longitudinally and therefore the first windings are impinged on by fresh air, while the subsequent ones are covered by the first ones and are therefore partly impinged on by already heated air; this involves a more reduced efficiency in terms of heat exchange, or in any case involves the requirement of decreasing the overall electric power transferred to the resistor, since the coils that are surrounded by hot air have to work in worse conditions as they are more subjected to burning or melting phenomena.

[0007] In addition, in the case of heating elements having a conical extension (or where the radii of the winding coils are variable), winding of the point with a smaller radius of curvature affects construction of the winding of the whole resistor, which on the sections having a greater radius of curvature, will give rise to a number of waves per turn smaller than the maximum possible one.

[0008] The above results in a non-optimal construction of the resistor that cannot be optimised in the different regions thereof.

[0009] It may also happen that due to the presence of cables, fastening elements of the motor, and all other things that are present in a heating apparatus, the air flow is thereby obstructed/affected and regions of the electrical resistor that are only partly impinged on by the air flow are defined; these regions tend to become overheated.

[0010] Therefore, the present invention aims at conceiving an electrical resistor or heating element for air-heating apparatus that is able to overcome the performance limits discussed above.

[0011] In particular, it is an aim of the present invention to conceive an electrical resistor that can be constructed in such a manner as to improve heat exchange with air.

[0012] The present invention also aims at making an electrical resistor offering the possibility of locally controlling the quality and amount of the heat-exchange processes between the resistance wire and the air impinging on it.

[0013] It is a further aim of the present invention to conceive an electrical resistor or heating element that can be shaped in several different ways, by a simple and quick production method (which can be also implemented on machinery of known type).

[0014] The foregoing and further aims are achieved by an electrical resistor in accordance with the present invention having the features disclosed in the appended claims and hereinafter illustrated in one embodiment thereof given by way of non limiting example, and in the accompanying drawings, in which:

- Fig. 1 shows a perspective view of a first embodiment of the present invention;
- Fig. 2 shows a front view of the embodiment seen in Fig. 1;
- Fig. 3 is a perspective view of a second embodiment of the invention;
- fig. 4 shows a front view of the embodiment in Fig. 3;
- Fig. 5 is a perspective view of a third embodiment of the invention;
- Fig. 6 is a front view of the embodiment seen in Fig. 5;
- Fig. 7 shows a perspective view of a fourth embodiment of the invention;
- Fig. 8 is a front view of the embodiment seen in Fig. 7;
- Fig. 9 is a perspective view of a fifth embodiment of the invention;
- Fig. 10 shows a front view of the embodiment seen in Fig. 9; and
- Fig. 11 is a front view of a sixth embodiment of the invention.

[0015] The electrical resistor according to the present invention substantially comprises at least one resistance wire 2 defining a predetermined number of coils 3 fitted along an extension axis 3a.

[0016] Conveniently this resistance wire 2 is shaped according to at least one predetermined wave form (and can therefore comprise sinusoidal and/or zigzag and/or square wave undulations and more generally undulations of any form).

[0017] At least one insulating support 4 is present which is adapted to support coils 3 and extends along the extension axis 3a.

[0018] Advantageously the wave form or forms visible on the resistance wire 2 define an undulation density D (i.e. a given number of undulations per unit length and/or width of angular arc) varying along the wire 2 itself.

[0019] Within the scope of the present invention, the possibility of varying the undulation density involves the possibility of having a localised dispersion power of the thermal energy of greater or lesser degree; in this way

therefore optimisation of the operating parameters of the electrical resistor is possible.

[0020] The variation modes of the undulation density D can be of any type depending on current requirements; for instance, the undulation density D can vary as a function of a linear coordinate along the extension axis 3a.

[0021] The undulation density D may also vary as a function of an angular coordinate around said extension axis 3a, or also as a function of the width of the angular arc and/or the radius of curvature of a coil 3 and/or an assembly of coils 3.

[0022] According to one embodiment of the present invention, the undulation density D varies (following a "discrete" sequence of values) along coils or coil assemblies, on the extension axis 3a so that, for instance, a given coil 3 at a predetermined linear coordinate along the extension axis 3a has a constant undulation density D along the whole radial extension thereof.

[0023] Therefore, it is advantageously possible to provide a construction architecture of the electrical resistor of such a nature that the first coils (i.e. those in the first section of axis 3a and which are impinged on by fresh air) have a greater undulation density, while the coils that are the closest to the end of axis 3a have a lower undulation density (because the air impinging on them has already been heated and therefore less heat supply is required). In other words, it is possible for the undulation density D to decrease in coils 3 and/or coil assemblies 3 as they are in a more forward position along the extension axis 3a.

[0024] At all events, depending on current requirements, it is also possible for the undulation density D to increase in the coils 3 or coil 3 assemblies as they are in a more forward position along the extension axis 3a; for instance, this increase in the undulation density can take place in those resistors the diameter of which increases along axis 3a.

[0025] In accordance with the present invention, the undulation density D is variable also locally (i.e. on coil portions as well) at or close to bodies connected with resistor 1; these bodies (that typically in a air-heating device can be electric cables and/or elements for securing the electrical resistor 1 to a machine body and/or fastening elements of an electric motor) in fact constitute disturbance/flow resistance elements for the air flow and therefore the present invention advantageously enables the undulation density to be locally modified so as to avoid creation of overheating phenomena at said bodies.

[0026] Obviously, in accordance with the present invention the undulation density D can be locally varied also at other types of different electric/mechanical components inserted into the body of the heating apparatus, such as ionising devices, thermostats and others.

[0027] According to a further feature of the present invention, the resistance wire 2 can have undulations of different geometric conformations; in particular, apart from the shape of these undulations, variation in the geometric conformations can take place depending on a linear coordinate along the extension axis 3a and/or as a function of a radial coordinate around the extension axis 3a and/or as a function of the width of the angular arc and/or the radius of curvature of a coil.

[0028] On the other hand, as regards support 4 and/or the general structure of the electrical resistor, this can be made following any arrangement; for instance, if in Figs. 1 to 10 examples of resistors defining a single "cylindrical heating body" can be seen, in Fig. 1 a socalled "coaxial resistor" is shown in which the resistance wire or wires form two heating bodies one of which is fitted in the other.

[0029] Conveniently, the coaxial condition (or in other words, the condition of coincidence of the axes of the heating bodies) is not essential; depending on current requirements, it is therefore possible to make an electrical resistor in which the resistance wire or wires form at least two heating bodies (that can be of cylindrical shape or of any other shape) fitted into each other.

[0030] If heating resistors of the "coaxial" type are wished to be made (or in any case resistors in which two or more heating bodies fitted within each other are defined, which however have misaligned and/or parallel axes) it is therefore suitable for support 4 to be shaped in such a manner that the "heating bodies" formed by the different coil series can be positioned and carried thereon.

[0031] Based on current requirements, support 4 can therefore comprise two (or more) under-supports 4a and 4b, each of which carries a series of coils 3.

[0032] In addition, one series of coils (preferably the innermost one) can be advantageously provided to act as under-support for the other series of coils and/or for the support of the last-mentioned series; in this manner an important reduction in costs and in the construction complexity of the finished product can be achieved.

[0033] It is also an aim of the present invention to provide a method of making an electrical resistor which is substantially implemented by arranging at least one insulating support 4 (preferably of electrical insulating material and extending along an extension axis 3a) and subsequently arranging a given number of coils 3 having at least one undulation density D on the insulating support 4 itself.

[0034] Arrangement of the coils takes place by tensioning and rolling up of a resistance wire 2, also taking advantage of the use of specialised machinery of known type.

[0035] Advantageously, the method of the invention contemplates a step of varying the undulation density D (that is preferably implemented as a function of a linear coordinate along the extension axis 3a and/or as a function of a radial coordinate around the extension axis 3a and/or as a function of the width of the angular arc and/or the radius of curvature of a coil).

[0036] In terms of execution, this step of varying the undulation density D is carried out through variation of a winding tension; in fact, through variation of the winding tension it is possible to modify the undulations making

them longer or shorter; in this way, more or less undulations can be obtained in a given section of wire, the length of the processed wire being the same.

[0037] With reference to the illustrations, the method involves changing of the number of waves upon changing of the radius of curvature, or more generally it will be recognised that the number of waves can vary along the winding coils.

[0038] Still with reference to the drawings, it is possible to see that the variation is localised at one sector or yet that the variation is localised at one region of the electrical resistor 1.

[0039] In short, the present invention relates to an electrical resistor for hairdriers and similar apparatus with a wave-shaped resistance wire (that depending on the method of shaping the resistance wire can also take equivalent names such as zigzag-wire resistor, sinusoidal or undulated-wire resistor, resistor having the shape of a Greek fret or particular geometric shapes, etc.) and which is made from one or more wires wound up into coils aligned on an insulating support; this electrical resistor is of such a nature that the number of waves per coil is not constant along the whole winding and/or is not constant in the sectors of the same coil.

[0040] The invention enables achievement of important advantages.

[0041] First of all, it will be appreciated that the new and original structural architecture of the electrical resistor (obtained through application of variations in the number of waves per turn and/or sector, during construction) enables an almost full control of the spatial re-distribution of the thermal power transferred to the air, thus ensuring benefits in terms of construction, performance and yield.

[0042] At the same time, by virtue of the present invention the electric power supplied to the resistor can be increased by introducing a greater number of waves (or, in other words, by increasing the undulation density) where the geometric conditions allow it.

[0043] A construction benefit is also achieved because a greater structural sturdiness of the winding is ensured, which is obtained by varying the wave number (and consequently the winding tension) in a localised manner, based on the requirements dictated by the elasticity of the shaped resistance wire.

Claims

1. An electrical resistor for hairdriers and similar apparatus, comprising:

   - at least one resistance wire (2) defining a predetermined number of coils (3) fitted along an extension axis (3a), said at least one resistance wire (2) being shaped according to at least one predetermined wave form; and
   - at least one insulating support (4) adapted to carry said coils (3) and extending along said extension axis (3a),

   characterised in that said at least one wave form defines a varying undulation density (D).

2. An electrical resistor as claimed in claim 1, **characterised in that** said undulation density (D) varies as a function of a linear coordinate along said extension axis (3a).

3. An electrical resistor as claimed in claim 1 or 2, **characterised in that** the undulation density (D) varies as a function of an angular coordinate around said extension axis (3a).

4. An electrical resistor as claimed in anyone of the preceding claims, **characterised in that** the undulation density (D) varies as a function of a width of an angular arc and/or a radius of curvature of a coil (3) and/or a coil (3) assembly.

5. An electrical resistor as claimed in anyone of the preceding claims, **characterised in that** the undulation density (D) varies along coils or coil assemblies along the extension axis (3a), a given coil (3) at a predetermined linear coordinate along the extension axis (3a) having a constant undulation density (D) along the whole radial extension thereof.

6. An electrical resistor as claimed in claim 5, **characterised in that** the undulation density (D) decreases or increases in the coils (3) and/or coil (3) assemblies as they are in a more forward position along the extension axis (3a).

7. An electrical resistor as claimed in anyone of the preceding claims, **characterised in that** the undulation density (D) is locally variable at or close to bodies connected with the resistor (1), said bodies preferably being electric cables and/or elements for securing the electrical resistor 1 to a machine body and/or fastening elements of an electric motor.

8. An electrical resistor as claimed in anyone of the preceding claims, **characterised in that** the resistance wire (2) has undulations having different geometric conformations, said geometric conformations varying as a function of a linear coordinate along the extension axis (3a) and/or as a function of a radial coordinate around the extension axis (3a) and/or as a function of a width of an angular arc and/or a radius of curvature of a coil.

9. An electrical resistor as claimed in anyone of the preceding claims, **characterised in that** said at least one resistance wire (2) defines at least two series of coils (3), one being fitted into the other, said

at least two series of coils (3) preferably being concentric and/or coaxial relative to each other, said at least two series of coils (3) more preferably forming two preferably cylindrical heating bodies.

10. An electrical resistor as claimed in claim 9, **characterised in that** the support (4) comprises at least two under-supports (4a, 4b), each of which carries one series of coils (3).

11. An electrical resistor as claimed in claim 9 or 10, **characterised in that** one series of coils (3), and preferably one innermost series of coils, acts as an under-support (4a) for the other series of coils (3) and/or for the support (4b) of the last-mentioned series.

12. A method of making an electrical resistor, comprising the following steps:

- providing at least one insulating support (4), preferably of electrical insulating material and extending along an extension axis (3a); and
- providing a predetermined number of coils (3) having at least one undulation density (D) on said insulating support (4) by tensioning and rolling up a resistance coil (2),

characterised in that it further comprises a step of varying said undulation density (D) preferably as a function of a linear coordinate along the extension axis (3a) and/or as a function of a radial coordinate around the extension axis (3a) and/or as a function of a width of an angular arc and/or a radius of curvature of a coil.

13. A method as claimed in claim 12, **characterised in that** said step of varying said undulation density (D) is carried out by varying a winding tension.

Amended claims in accordance with Rule 137(2) EPC.

1. An electrical resistor for hairdryers, comprising:

- at least one resistance wire (2) defining a predetermined number of coils (3) fitted along an extension axis (3a), said at least one resistance wire (2) being shaped according to at least one predetermined wave form; and
- at least one insulating support (4) adapted to carry said coils (3) and extending along said extension axis (3a);
- said at least one wave form exhibiting an undulation density (D) which varies along said at least one resistance wire;

characterised in that
said undulation density (D) varies as a function of a linear coordinate along said extension axis (3a) and of an angular coordinate around said extension axis (3a).

2. An electrical resistor as claimed in claim 1, **characterised in that** the undulation density (D) varies as a function of a width of an angular arc and/or a radius of curvature of a coil (3) and/or a coil (3) assembly.

3. An electrical resistor as claimed in anyone of the preceding claims, **characterised in that** the undulation density (D) varies along coils along the extension axis (3a), a given coil (3) at a predetermined linear coordinate along the extension axis (3a) having a constant undulation density (D) along the whole radial extension thereof.

4. An electrical resistor as claimed in claim 3, **characterised in that** the undulation density (D) decreases or increases in the coils (3) along the extension axis (3a).

5. An electrical resistor as claimed in anyone of the preceding claims, **characterised in that** the undulation density (D) varies at or close to bodies connected with the resistor (1), said bodies preferably being electric cables and/or elements for securing the electrical resistor 1 to a machine body and/or fastening elements of an electric motor.

6. An electrical resistor as claimed in anyone of the preceding claims, **characterised in that** the resistance wire (2) has undulations having different wave form, said wave form varying as a function of a linear coordinate along the extension axis (3a) and/or as a function of a radial coordinate around the extension axis (3a) and/or as a function of a width of an angular arc and/or a radius of curvature of a coil.

7. An electrical resistor as claimed in anyone of the preceding claims, **characterised in that** said at least one resistance wire (2) defines at least two series of coils (3), one being fitted into the other, said at least two series of coils (3) preferably being concentric and/or coaxial relative to each other, said at least two series of coils (3) more preferably forming two preferably cylindrical heating bodies.

8. An electrical resistor as claimed in claim 7, **characterised in that** the support (4) comprises at least two under-supports (4a, 4b), each of which carries one series of coils (3).

9. An electrical resistor as claimed in claim 7 or 8, **characterised in that** one series of coils (3), and

preferably one innermost series of coils, acts as an under-support (4a) for the other series of coils (3) and/or for the support (4b) of the last-mentioned series.

10. A method of making an electrical resistor, comprising the following steps:

- providing at least one insulating support (4), preferably of electrical insulating material and extending along an extension axis (3a); and
- providing a predetermined number of coils (3) having at least one wave form on said insulating support (4) by tensioning and rolling up a resistance coil (2),

characterised in that it further comprises a step of varying said wave form preferably as a function of a linear coordinate along the extension axis (3a) and as a function of a radial coordinate around the extension axis (3a) and/or as a function of a width of an angular arc and/or a radius of curvature of a coil.

11. A method as claimed in claim 10, **characterised in that** said step of varying said undulation density (D) is carried out by varying a winding tension.

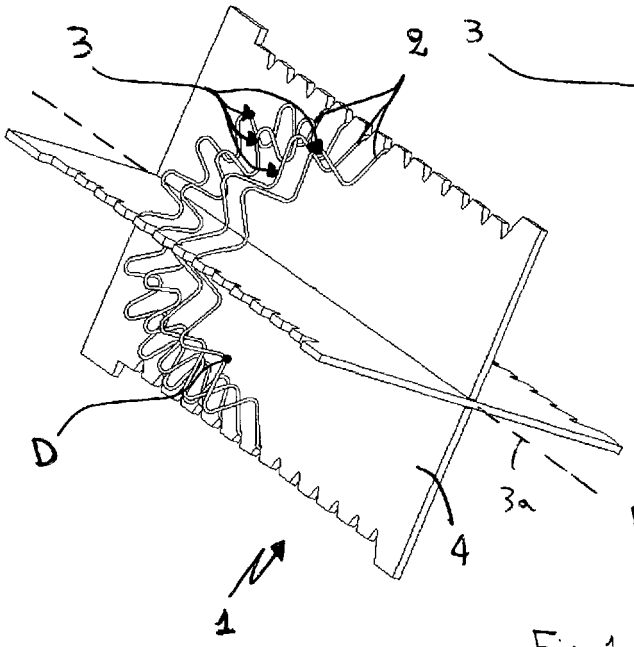

Fig. 1

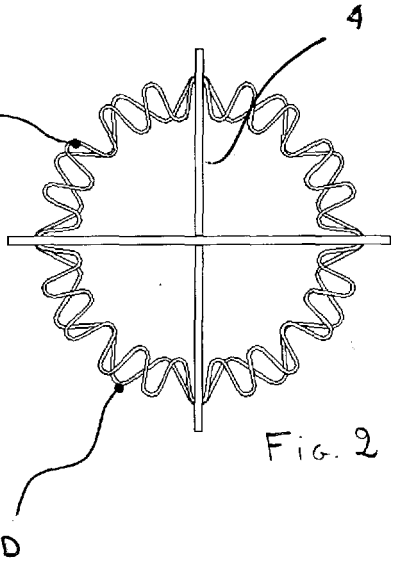

Fig. 2

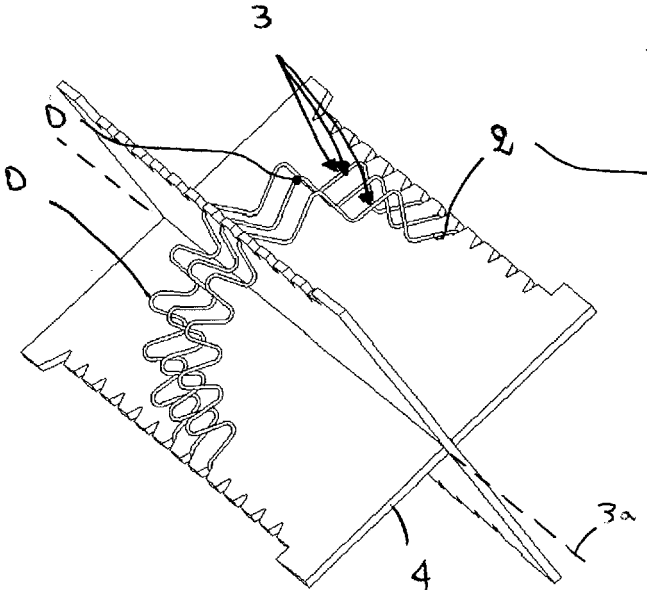

Fig. 3

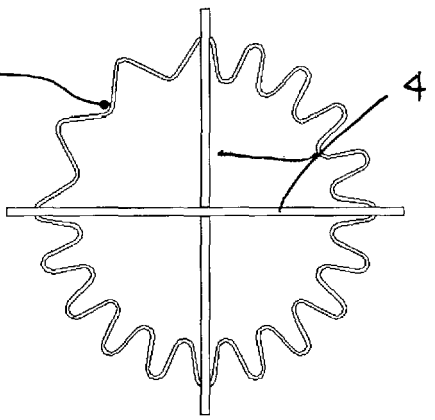

Fig. 4

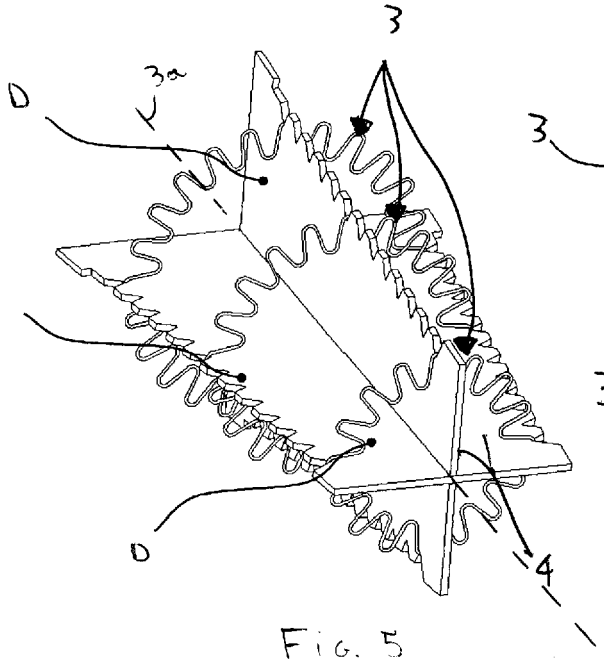

Fig. 5

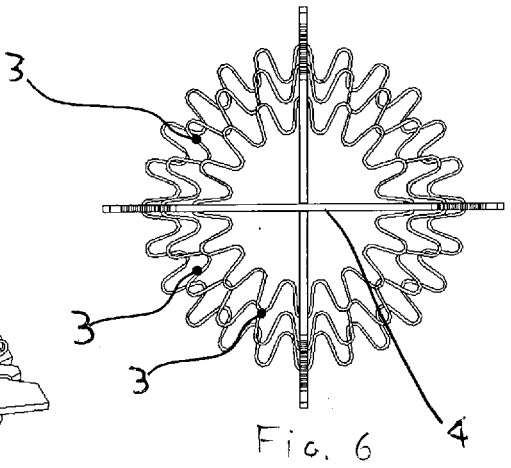

Fig. 6

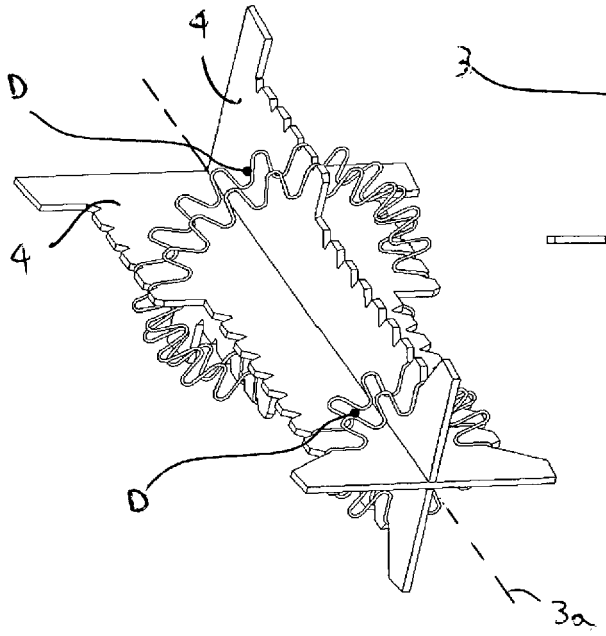

Fig. 7

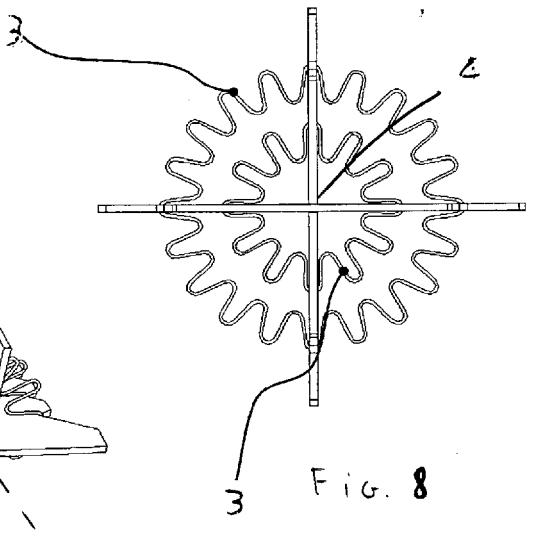

Fig. 8

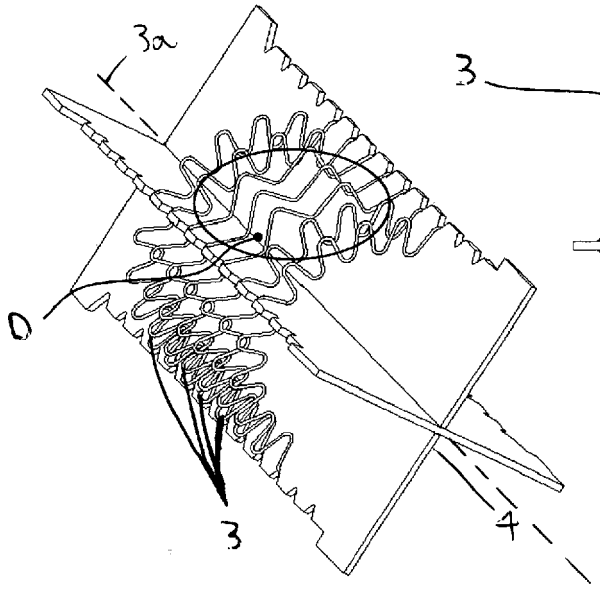

Fig. 9

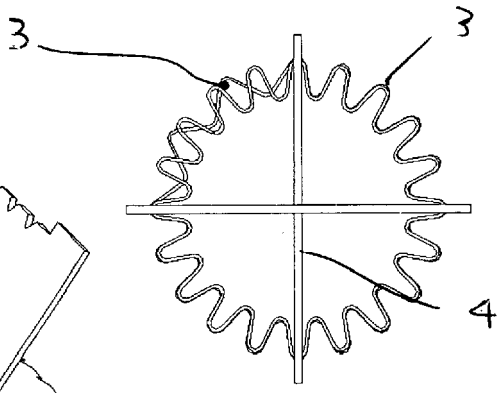

Fig. 10

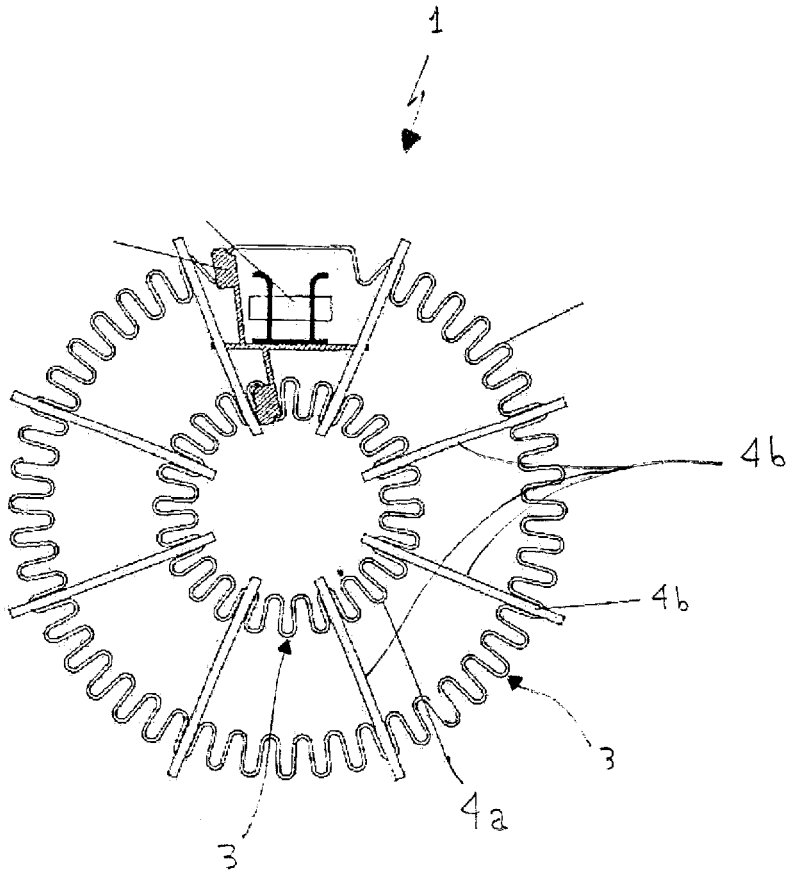

Fig. 11

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 10 3966

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 418 794 A1 (EICHENAUER HEIZELEMENTE GMBH & [DE]) 12 May 2004 (2004-05-12) * figures 1c,2 *	1-13	INV. H01C3/08 H01C3/10 H05B3/16
X	EP 0 038 414 A1 (BRAUN AG [DE]) 28 October 1981 (1981-10-28) * figure 6 *	1-13	A45D20/00
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TECHNICAL FIELDS SEARCHED (IPC)

H01C
H05B
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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	14 August 2007	Plützer, Stefan

CATEGORY OF CITED DOCUMENTS

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14-08-2007

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