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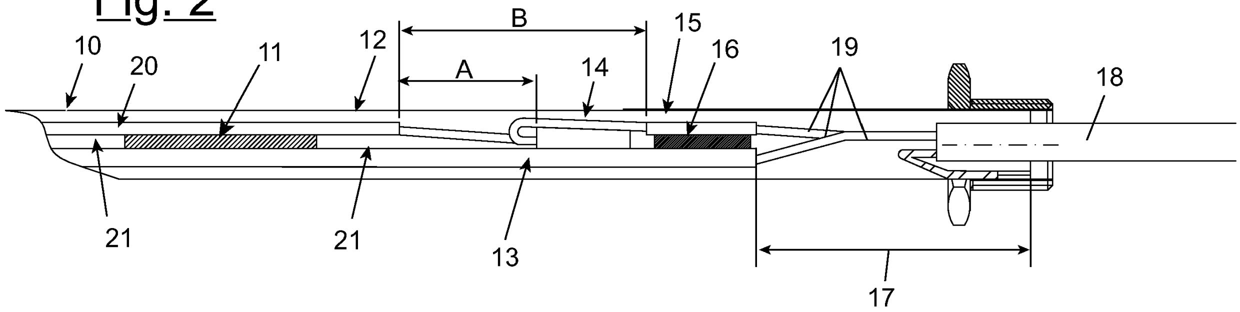
(54) Electric resistance with low energy consumption PTC heating elements

(57) An electric resistance with low energy consumption PTC heating elements, of the type comprising a tubular container (10), which forms the outer casing of the resistance and which contains a first layer of insulating material (20), at least one operating heating element, consisting of at least a first PTC plate (11), closed between a first (12) and a second diffusor (13), and at least a second layer of insulating material (21), consisting of magnesium oxide powder, which fills all the spaces available around the first PTC plate (11), inside the electric resistance there is also a thermostat (14), normally closed and situated at a certain distance (A) from the first diffusor (12), a third diffusor (15), situated at a pre-established distance (B) from the above first diffusor (12), and a maintenance heating element, consisting of at least a second PTC plate (16) closed between the third (15) and second diffusor (13) and positioned adjacent to the thermostat (14).

Fig. 2



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Description

[0001] The present invention relates to an electric resistance with low energy consumption PTC heating elements,

[0002] For the production of double insulation resistances, resort is normally made to the use of insulating materials, such as magnesium oxide in the form of granules, combined with structures generally consisting of a double round of Kapton® or Teflon®.

[0003] A first type of resistance of this kind envisages the use of a coil of resistive wire inserted inside a tubular container, generally metallic, filled with magnesium oxide powder.

[0004] The tubular container is inserted inside a second tube, having a greater diameter, and the hollow space is also filled with magnesium oxide, which is subsequently pressed and made compact.

[0005] One of the main disadvantages of this structure lies in the fact that, for many applications, the measurement of the diameter obtained is considered excessive.

[0006] A second type of double insulation resistance is obtained by positioning the coil of resistive wire inside a tube, which is filled with magnesium oxide powder, and subsequently coating the above tube with a double layer of Kapton® or Teflon®, before inserting it in a second tubular container which forms the outer casing.

[0007] This type of construction allows resistances with smaller diameters to be obtained, it is necessary however to envisage the use of further control and/or safety devices, such as manually operated thermostats and/or thermofuses, for the functioning of the resistance at certain threshold temperatures.

[0008] Double insulation resistances with heating elements consisting of PTC elements are also known.

[0009] In this case, there is a double layer of insulating material, such as Kapton® or Teflon®, inside a tube and a heating element consisting of one or more PTC elements closed between a pair of diffusors is inserted in the tube, the whole unit being centered by means of centering rings; the space around the heating element is filled with pulverized insulating material, in particular magnesium oxide, and finally the insulating material is suitably compacted.

[0010] Electric resistances are obtained in this way, in which it is no longer necessary to insert control and/or safety devices, such as thermostats and/or thermofuses, the necessary insulation being in any case ensured, as the heating element, according to the operating environment (water, other fluids or air), regulates the current adsorption.

[0011] In particular, the resort to magnesium oxide having a certain average particle-size, allows the insulating material to be compacted inside the tube containing the PTC elements, without damaging the outer coating made of Kapton®.

[0012] Also in this case, however, the use of a thermostat of the automatic type has various drawbacks, among which that of comprising too many on/off cycles, with a consequent limited average life of the component.

[0013] Furthermore, the current value and therefore the power developed by the component immersed in water or other fluid, is higher than that developed by the component immersed in air, and this value also strictly depends on the number of PTC elements inserted.

[0014] Figure 1 enclosed shows a sectional view of a resistance made of heating elements consisting of traditional PTC elements.

[0015] In particular, in this case, a layer of insulating material 3 is inserted inside a substantially tubular container, marked by 4 in figure 1, which represents the outer casing of the resistance, and which has a cold front portion 7 in correspondence with the connecting cable 8, and of the further electric connections 9.

[0016] One or more centering elements are inserted in the tube 4, consisting, for example, of rings made of Teflon®, silicon rubber or other material capable of resisting the temperatures developed by the resistance and, subsequently the heating element, consisting of one or more PTC plates, marked by 1 in the enclosed figure 1, closed between a couple of diffusors 2, made, for example, of aluminum.

[0017] These diffusors 2 preferably have the shape, in section, of a circular sector, whose bending radius corresponds to the radius of the inner surface of the centering elements, and have shaped ends, so as to define protruding longitudinal pairs of edges 5, to allow a safer assembly of the PTC 1 plates, preventing these from extending outwards, partially or totally, from the diffusion elements 2, thus ensuring an optimal electric contact.

[0018] The centering elements have an annular inner surface and a polygonal outer surface, hexagonal, for example, to allow an easy passage of the magnesium oxide powder, which is subsequently introduced, to prepare the primary insulating layer 6.

[0019] Finely ground magnesium oxide is in fact introduced after the insertion of the heating element into the tube 4, and fills all the available spaces around the heating element, forming the primary insulation.

[0020] Once the inside of the resistance has been filled with magnesium oxide, the same is compacted and/or compressed, for example by hammering, before completing the resistance by sealing the tube 4.

[0021] The product is used in a mixed water (or other liquids)/air environment, and must act as an evaporator, whereas the heating element, consisting of the PTC plates 1, according to the operating environment (water and other liquids or air), regulates the current adsorption.

[0022] Consequently, as specified above, in the traditional solution, according to which the PTC plates 1 are fed by means of the aluminum diffusors 2, the current adsorption and, therefore, the power developed in the liquid is greater than that in air and strictly depends on the number of heating elements inserted (or PTC plates 1).

[0023] In particular, it can be observed that, if we consider a resistance having an absorbed power in liquid equal to 750 W, once the liquid has evaporated, the adsorption in free air remains constant, and is equal to about 80 W under regime conditions.

[0024] This creates the necessity of limiting the consumptions.

[0025] An objective of the present invention is therefore, in general, to overcome the above drawbacks and, in particular, to provide an electric resistance with PTC heating elements having a low energy consumption, in which the current adsorption and, therefore, the power developed, are independent of the number of PTC elements inserted.

[0026] Another objective of the present invention is to provide an electric resistance with low energy consumption PTC heating elements, which is particularly efficient and reliable and which allows the production and running costs to be reduced, with respect to the known art.

[0027] These and other objectives are achieved by an electric resistance with PTC heating elements, having a low energy consumption, according to the enclosed claim 1; other detailed technical characteristics are contained in the dependent claims.

[0028] Further characteristics and advantages of the present invention will appear more evident from the following description, relating to an illustrative and preferred but non-limiting embodiment of the low energy consumption electric resistance, according to the invention, and from the enclosed drawings, wherein:

- figure 1 is a schematic transversal sectional view of an electric resistance with PTC heating elements, according to the known art;
- figure 2 is a schematic transversal sectional view of an electric resistance with low energy consumption PTC heating elements, according to the present invention.

[0029] With particular reference to the enclosed figure 2, it should be noted, first of all, that the electric resistance with PTC heating elements, having a low energy consumption, according to the present invention, is made analogously to an electric resistance with traditional PTC elements, such as that shown in figure 1, and is used analogously, in a mixed water (or other liquids)/air environment, acting as an evaporator.

[0030] The electric resistance, in fact, comprises a tubular container 10, which represents the outer casing of the resistance, which has a front cold portion 17 in correspondence with the connecting cable 18 and further electric connections 19.

[0031] A layer of insulating material 20 is inserted inside the tubular container 10, together with one or more centering elements not shown in the enclosed figure 2), consisting, for example, rings made of Kapton® or Teflon®, silicon rubber or other material capable of resisting the temperatures developed by the resistance.

[0032] Furthermore, an operating heating element 11 is inserted inside the container 10, consisting of at least one PTC plate, closed between a pair of diffusors 12, 13, made, for example, of aluminum.

[0033] Finely ground magnesium oxide in powder form is subsequently introduced, in order to provide the primary insulating layer 21, which fills all the available spaces around the operating heating element 11.

[0034] Once the inside of the electric resistance has been filled with the layer 21 of magnesium oxide, the latter is compressed and/or compacted, for example by hammering, before completing the resistance by sealing the tubular container 10.

[0035] According to the present invention, a thermostat 14 is also inserted inside the electric resistance, normally closed and positioned at a distance A from the diffusor 12, together with another diffusor 15, situated at a distance B from the diffusor 12, and another PTC maintenance plate, marked by 16 in figure 2, closed between two diffusors 15 and 13, and situated in an adjacent position with respect to the thermostat 14.

[0036] The constructive solution of figure 2, according to the invention, behaves in the same manner as the traditional constructive solution when the resistances are immersed in a liquid, during evaporation, for functioning in vacuum, however, the behaviour is completely different.

[0037] Under the vacuum functioning condition only (resistance in free air), in fact, it can be observed that :

- in the traditional constructive solution, wherein the PTC plates 1 are fed through the aluminum diffusors 2, the power adsorption depends on the number of PTC elements inserted, and can reach, for example, 80 W when the resistance has an adsorption power in liquid equal to 750 W (enclosed figure 1);
- in the constructive solution according to the invention (figure 2), the operating plates PTC 11, fed by the diffusors 12 and 13, are excluded from functioning at the very moment in which the opening temperature of the calibrated thermostat 14 is reached and, in this phase, the only power adsorption is due to the maintenance PTC plate 16.

[0038] In particular, the maintenance plate 16 consists of a plate having a calibration at a higher temperature with respect to the regenerating temperature of the thermostat 14, so that the thermostat 14 does not close until the environmental temperature decreases below a certain value (regenerating temperature) and therefore until a new filling of the container in which the resistance with liquid is situated.

[0039] In practice, the intervention of the thermostat 14, as with each subsequent regeneration, with the opening of the contacts, when the resistance is again immersed in the liquid, lowers the vacuum absorbed power, whereas in the interval phase, during which the resistance is uncovered (in the air), the power adsorption is practically blocked at a value lower than 10 W and the thermostat does not effect cycles.

[0040] In conclusion, in the example considered of resistances having an adsorption power in liquid equal to 750 W, the constructive solution described according to the invention allows passage from a developed power of about 80 W (according to the traditional solution) to a developed power equal to or lower than 10 W, thus obtaining a considerable decrease in energy consumption, with respect to the known art.

[0041] It has been observed that the insertion of a particular thermostat 14, of the automatic type, connected to a new (maintenance) PTC plate 16, differently calibrated with respect to the operating PTC plate 11, at such a temperature that the thermostat 14 intervenes, allows the contacts of the thermostat 14 to be kept open, until a new level of air and/or water or other liquid, is reached.

[0042] The characteristics of the electric resistance having low energy consumption PTC heating elements, object of the present invention, are evident from the above description, as are also the relative advantages.

[0043] Finally, numerous other variations can obviously be applied to the electric resistance in question, still remaining within the novelty principles contained in the inventive idea, and it is also evident that, in the practical embodiment of the invention, the materials, forms and dimensions of the details illustrated can vary according to the requirements, and can be substituted with other technically equivalent alternatives.

Claims

1. An electric resistance with low energy consumption PTC heating elements, of the type comprising a tubular container (10), which forms the outer casing of the resistance and which contains a first layer of insulating material (20), at least one operating heating element, consisting of at least a first PTC plate (11), closed between a first (12) and a second diffusor (13), and at least a second layer of insulating material (21), which fills all the spaces available around the first PTC plate (11), **characterized in that** inside the electric resistance there is also at least one thermostat (14), normally closed and situated at a certain distance (A) from said first diffusor (12), at least a third diffusor (15), situated at a pre-established distance (B) from said first diffusor (12), and at least one maintenance heating element, consisting of at least a second PTC plate (16) closed between said third (15) and said second diffusor (13) and positioned adjacent to said thermostat (14).

2. The electric resistance according to claim 1, **characterized in that** said resistance is used in a mixed environment of water or other liquids/air, acting as evaporator.

3. The electric resistance according to claim 1, **characterized in that** said tubular container (10) has a cold portion (17), positioned in correspondence with at least one connecting wire (18) and/or of further electric connections (19).

4. The electric resistance according to claim 1, **characterized in that**, under a vacuum operating and/or free air condition of said electric resistance, said first PTC plate (11), fed by said first diffusor (12) and second diffusor (13), is excluded from functioning, at the very moment in which a first pre-established temperature value is reached, corresponding to a first calibration value suitable for the opening of said thermostat (14).

5. The electric resistance according to claim 4, **characterized in that**, under such conditions, the sole current absorption is due to said second PTC plate (16).

6. The electric resistance according to claim 4, **characterized in that** said second plate (16) has a second calibration value, corresponding to a second temperature value, higher than said first calibration value of the thermostat (14), so that said thermostat (14) does not close until the temperature of the environment has dropped to below a certain value and, therefore, until a new level of liquid, in which the resistance is positioned, is reached.

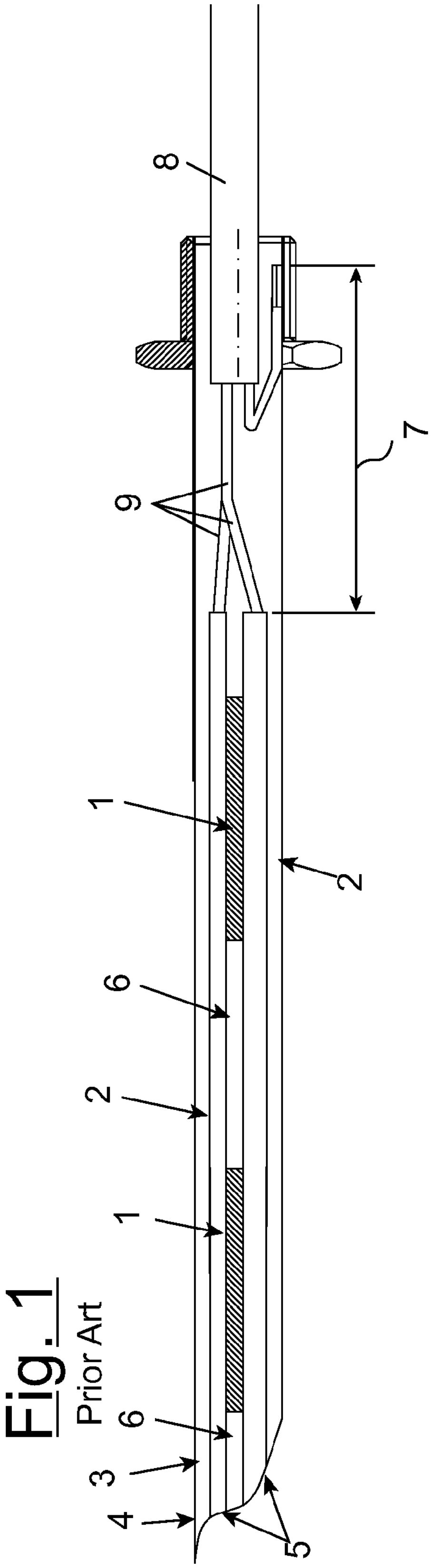
Fig. 1
Prior Art
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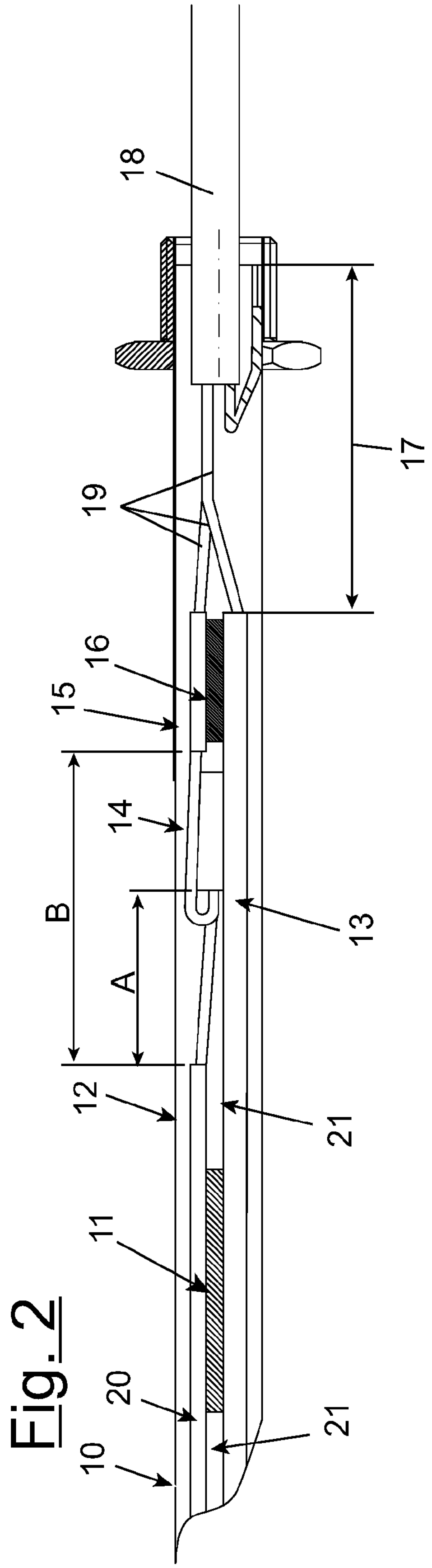
Fig. 2
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Application Number
EP 06 12 5385

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)
H05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 April 2007	DE LA TASSA LAFORGUE

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