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[54] HEATING ELEMENTS FOR HEAT-TREATING THREADS

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[58] **Field of Search** 165/77; 28/62

[56] **References Cited**

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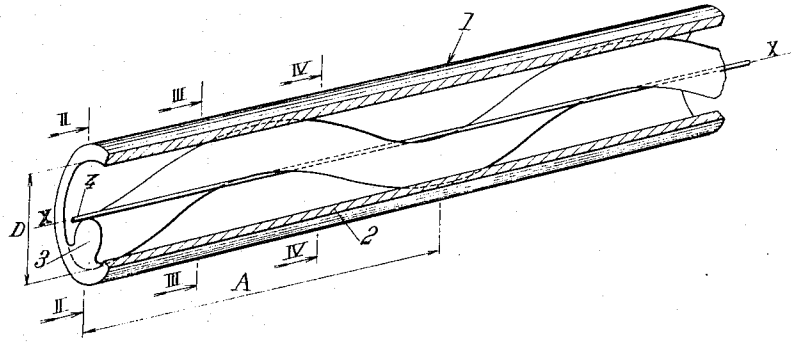
[57] **ABSTRACT**

The element is a tube with a zone of its inner wall extended radially close to its axis over a helicoidal track extending through the tube. The thread can thus be passed axially through the tube and heated by conduction through the zone, whilst being simultaneously heated by radiation from the tube wall and by convection from a hot fluid circulated through the tube.

11 Claims, 8 Drawing Figures



HEATING ELEMENTS FOR HEAT-TREATING THREADS

The invention relates to heating elements for the thermal treatment of threads, especially threads intended for the textile industry, in particular for false-twisting machines which process synthetic and artificial filaments.

Up to the present, the transmission of heat energy between a heating element and the thread to be treated, is effected, either by conduction, the thread to be heated being in contact with a hot surface, or by radiation, the thread to be heated being surrounded by a hot wall, or by convection, the thread to be heated being subjected to the action of a hot fluid, and no heating element existed capable of applying simultaneously two methods of transmitting heat energy as is concerned above, or even the three above-said methods of transmission.

It is a particular object of present invention, to render the above-said heating elements such that they respond better than hither to the various desiderata of practice, especially as regards efficiency of the heat energy transmission between the heating element and the thread to be treated.

The heating element according to the invention is characterized by the fact that it comprises a tube of which the wall has at least one inner zone extending, radially up to the neighborhood of the axis of the tube, the distance between this inner zone and the axis of the tube being preferably equal to the radius of the thread to be treated, and, coaxially over the whole or part of the length of the tube by following a helicoidal track, the thread to be treated which passes coaxially through this heating element being thus in contact with the above-said inner zone which surrounds this thread, so that the transmission of heat energy between the heating element and the thread to be treated is effected at the same time by conduction (since the thread is in contact with the inner zone over the whole length of the heating element), by radiation (since the thread is held coaxially in the tube and receives heat energy radiated perpendicularly towards the inside by the wall of the tube), and by convection (since the thread is bathed by a helicoidal flow of hot fluid circulating on the inside of the tube and guided by the inner zone).

The invention consists, apart from this main feature, in certain other features which are preferably used at the same time and which will be more explicitly considered below.

In order that the invention may be more fully understood, several preferred embodiments of heating elements according to the invention are described below purely by way of illustrative but non-limiting examples, with reference to the accompanying drawings in which:

FIG. 1, shows a partial diagrammatic view in perspective, with portions removed, of a first embodiment of a heating element according to the invention;

FIGS. 2, 3 and 4 are respectively an end view and two cross-sections of this heating element, along the planes II, III and IV of FIG. 1; and

FIGS. 5, 6, 7 and 8 are cross-sections showing respectively other embodiments of a heating element according to the invention.

As shown in FIGS. 1 to 4, the heating element according to the invention includes a tube 2 of which the wall has an inner zone 3 which extends, radially up to the neighborhood of the axis XX of the tube 2, the distance between this inner zone 3 and the axis XX of the tube 2, being equal to the radius of the thread to be treated 4, and axially over the whole length of the tube 2 by following a helicoidal track.

The thread to be treated 4 passes coaxially through this heating element 1 and it is thus in contact with the inner zone 3 which surrounds thread 4.

Under these conditions, the transmission of heat energy between the heating element 1 and the thread to be treated 4 is carried out at the same time,

by conduction, since the thread 4 is in contact with the inner zone 3 over the whole length of the heating element 1,

by radiation, since the thread 4 is held coaxially in the tube 2 and receives heat energy radiated perpendicularly towards the interior by the wall of the tube 2,

and by convection, since the thread 4 is bathed by a helicoidal flow of hot fluid circulating inside the tube 2 and guided by the inner zone 3 (natural circulation or forced circulation of hot fluid).

In other embodiments of the invention, not shown, the tube could include several inner zones each extending radially up to the neighborhood of the axis of the tube and axially over the whole length of the tube by following a helicoidal track, these inner zones being regularly distributed over the wall of the tube (in the manner of helicoidal threads of a multiple thread screw).

In the case of the embodiment shown in FIGS. 1 to 4, tube 2 includes therefore a single inner zone 3.

It is appropriate then to specify that the ratio between the pitch A of the helicoidal track of this inner zone 3 and the inner diameter D of tube 2 is advantageously comprised between 10 and 50.

The pitch A of the helicoidal track of the inner zone 3 can be constant over the whole length of the tube 2 or variable over this length.

By means of such a choice, there is obtained a good transmission of heat energy by conduction since the length of the contact between the inner zone 3 and the thread 4 reaches a high value, and by convection since the helicoidal flow of the hot fluid circulating inside the tube 2 is homogenized in adequate manner.

In the embodiment illustrated in FIGS. 1 to 4 and 6, the inner zone 3 has a solid section, the tube 2 preserving a circular outer cross-section.

In the embodiment illustrated in FIGS. 5 and 7, in which the same reference numerals denote the same members as in FIGS. 1 to 4, the inner zone 3 has a hollow cross-section and it is obtained by deformation of the tube 2. In this case, the tube 2 no longer has a circular outer cross-section, but this outer cross-section remainsinscribed in this tube 2 before deformation.

In the embodiment illustrated in FIG. 8, of which the same reference numerals denote the same members as in FIGS. 1 to 4, the inner zone 3 has a flat cross-section as it is constituted by a diametrical zone. In this case, also, the tube 2 no longer has a circular outer cross-section, but this outer cross-section remains inscribed in that of a tube which would have the same outer diameter as the tube 2 constituting the heating element 1.

As a result of which and whatever the embodiment adopted, the heating element applies the three methods of transmission of heat energy and, through this fact, it ensures efficient and rapid heating of the thread to be treated. Moreover, the heating element has externally the shape of a rectilinear tube, which enables easy positioning in particular heating blocks and enables also simple mounting in already existing heating assemblies in the place of the conventional heating elements, in order to improving the yield of these heating assemblies.

As is self-evident and as emerges already besides from the preceding description, the invention is in no way limited to those of its methods of application, nor to those of its methods of production of its various parts which have been more particularly indicated; it embraces, in the contrary, all variations.

What I claim is:

1. An arrangement for the thermal treatment of threads by a heating fluid, comprising a tube through which the thread to be treated is passed along an axial path, said tube having a circumferentially closed wall having at least one helicoidal inner zone extending close to said axial path of said thread over at least part of the length of said tube so as to be in contact with a thread moving along said axial path, whereby when a heating fluid is passed through said tube, heat is transferred to the thread not only by convection from the fluid but also by heat conduction from said inner zone in contact with the thread and by heat radiation from the inner wall surface.

2. The arrangement as defined in claim 1, wherein said helicoidal inner zone is constituted by a radially inwardly curving ridge of said circumferentially closed tube wall, said ridge hav-

ing a helicoidal apex line extending about the axis of said tube closely adjacent thereto so as to contact a thread passed coaxially through said tube.

3. The arrangement according to claim 1, wherein the distance between the inner zone and said axis is equal to the radius of the thread to be treated.

4. The arrangement according to claim 1, comprising a single inner zone.

5. The arrangement according to claim 1, wherein the ratio between the pitch of said helicoidal inner zone and the inner diameter of the tube is from 10 to 50.

6. The arrangement according to claim 1, wherein the pitch of said helicoidal inner zone is constant over the whole length of the tube.

7. The arrangement according to claim 1, wherein the pitch of said helicoidal inner zone varies over the length of the tube.

8. The arrangement according to claim 1, wherein said inner zone is of solid cross-section.

9. The arrangement according to claim 1, wherein said inner zone is of flat cross-section and is constituted by a diametric zone.

10. The arrangement according to claim 1, wherein said inner zone is of hollow cross-section.

11. The arrangement according to claim 10, wherein said inner zone is obtained by deformation of the tube.

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