LOW THERMAL LOSS ELECTRIC HEATER FOR SYNTHETIC YARNS

INVENTORS
HAL JONES, JR.
WILLIAM H. WOOD

BY

John B. Spencer
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Hal Jones, Jr., and William H. Wood, Roundoke, Va., assignors to General Electric Company, a corporation of New York
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This invention relates to electrical heating devices, and, more particularly, to electric resistance-type heating devices used in the processing of synthetic yarns.

More specifically, the invention is related to a heating device utilized in the drawing and twisting of synthetic fibers, wherein the temperature gradient necessarily must be controlled precisely at all times and conditions of operation, through the use of a heating element of low thermal mass insulated from both conductive and convective heat losses normally brought about by the design and arrangement of the mechanical supporting structure. Heat losses via conduction are reduced by providing a minimum of heating element supports and losses arising from convection are reduced by shielding the heating element mechanically, the heating element being arranged in a manner to supply heat to a moving synthetic fiber filament in continuous contact therewith.

In the processes of manufacturing threads and the like from synthetic fibers such as nylon, polyester and polypropylene it is necessary to both draw and twist the fibers by mechanical means. During the processes these fibers undergo certain stretching and deformation unless carefully controlled heating of the fibers is maintained whereby unsatisfactory finished threads and the like result, particularly in respect to uniformity. Since the only reliable means of testing these threads appears to be by weaving the threads into cloth, dyeing the cloth, and comparing the resulting dye absorption and texture for overall uniformity, the design and construction of the heating devices is extremely critical.

The present invention therefore is directed to an improved heating device for use in the controlled heating of such fibers during such processes. More specifically, however, since the process of producing synthetic threads is normally performed upon special "draw-twist" machines utilizing pre-heaters, auxiliary heaters and main heaters, the latter being applied at a crucial point in the operation of the process, this invention is directed to the design of an improved "main" heater. The main heater is normally required to have low thermal mass to accommodate sudden temperature changes caused by load fluctuation and for immediate "start-up." Of necessity, therefore, the main heating device must have low heat losses.

It is therefore an object of this invention to provide a heating device having low thermal mass and high efficiency.

Since the main heater is also exposed to extral heat introduced by convection, it is also important that the heater be protected from such sources of heat loss in view of the sensitivity of the process to uncontrolled heating changes.

Another object of the invention is, therefore, to provide a heating device having a maximum protection against external heat losses.

Still another object of the invention is to provide a heating device having insulation from heating losses due to conduction to the metal portions of the mechanical components providing the drawing and twisting operations.

A further object of the invention is to provide a heating device having ease of threading and affording maximum protection to the operators against accidental contact with the heating surfaces.

The invention is set forth with particularity in the appended claims. The principles and characteristics of the invention, as well as other objects and advantages are revealed and discussed through the medium of the illustrative embodiments appearing in the specification and drawings which follow.

In the drawings:
FIGURE 1 is a perspective view of the heating device showing a synthetic fiber passing over the heating surface.
FIGURE 2 is an exploded view of the heating device illustrating the various elements and components comprising the heater.
FIGURE 3 is a partial sectional view of the principal active parts of the heating device.
FIGURE 4 is a partial view in perspective of the heater element providing the source of heating energy.

Referring now to FIGURE 1 a molded asbestos box 10 is provided with yieldable wear strip 11 (later explained in more detail herein) over which a strand or fiber of yarn 12 is passed to be heated. The form and shape of the box 10 is so arranged to have similar and parallel flanges 13 arranged above the wear strip 11 to provide therewith a trough-shaped receptacle through which the fiber 12 passes. These flanges not only provide limits of travel for the strand or fiber passing over the wear strip 11, but also serve as a means for the operator to avoid contact with the latter when threading the fiber and in sheltering the fiber within the aforesaid trough from air currents and similar convection effects of air moving across the box 10.

In FIGURE 2 and FIGURE 3 more details of the heater are shown. On the underside of the wear strip 11, and bonded to it by a high temperature cement is a resistance heating element 14 (see also FIGURE 4) comprising a sandwich structure having a mica insulating strip 14a, a resistance wire wound mica strip 14b and another mica insulating strip 14c. At the center of the wear strip 11 located between it and the bonded mica sandwich is a thermistor or thermo-couple 15. A stainless steel strip 16 is wedged or otherwise clamped into the underside of the wear strip 11, thereby clamping the heating element 14 against the underside of the wear strip 11.

The wear strip 11 is composed of copper or some similar material having good heat conductivity, and is shaped somewhat accurately having its ends curled downwardly and terminating in legs 17a and 17b. The heating element 14 and the clamping strip 16 follow the same contour as the wear strip 11, each terminating inside the respective curls of the wear strip and the winding of the heating element having leads 18 and 19. Molded asbestos blocks 18a and 18b are fitted into the ends of the wear strip for supporting the wear strip via the legs 17a and 17b, the blocks each having transverse openings corresponding to ears 20a, 20b, 20c, and 20d on the inside ends of the halves 10a and 10b of the box 10. A second stainless steel strip 21 is arranged to engage at its ends a pair of notches 22a and 22b on the inner sides of the blocks 18a and 18b, respectively, the strip 21 thereby being bent in a manner to bear against the underside of the strip 16 to further support the wear strip 11 and the heating element and clamping strip assembly previously described above.

As noted above in FIGURE 3 the box 10 is shaped to accommodate the peculiar configuration of the wear strip 11 and its associated strips so that the only actual contact with the box 10 is via the aforesaid ears 20a, 20b, 20c, 20d, and the corresponding blocks 18a and 18b, the latter being clamped between the former under pressure of mounting screws passing through holes in these members and in the halves of the box 10.
Electrical leads are provided from the thermistor or thermo-couple to terminals provided on the box, and the leads from the heating element are also connected to similar terminals on the box. A locating pin is provided in one half of the box for accurate assembly of the two halves, and additional clamping screws may also be provided for more securely fastening the two halves. The box is mounted by threaded bushings embedded in the molded asbestos.

One of the novel features of the heater is that the wear strip with its associated heating element and clamping strips is yieldably supported solely within the box upon the blocks thereby greatly reducing heat losses. Furthermore, since the molded box provides a means whereby there is no metal to metal contact between the wear strip and the metallic machine upon which it may be mounted, additional heat isolation is provided. Finally, since the mass of the elements actually heated is confined to the wear strip and its associated clamping strips, a relatively low thermal mass is provided whereby heat control is more easily and more rapidly obtained.

While the invention has been explained and described with the aid of particular embodiments thereof, it will be understood that the invention is not limited thereby and that many modifications retaining and utilizing the spirit thereof without departing essentially therefrom will occur to those skilled in the art in applying the invention to specific operating environments and conditions. It is therefore contemplated by the appended claims to cover all such modifications as fall within the scope and spirit of the invention.

What is claimed is:

1. A device for supplying heat to endless filaments passing thereover comprising an elongated, arcuate strip of conductive metal, said filaments passing over the convex side of said strip, a heating element attached to the concave side of said strip, a non-conducting housing, a pair of non-conducting blocks within and attached to the extremities of said housing, and a springlike member extending between said blocks and arranged to mount said strip in said housing in yieldable relationship therewith.

2. A device for supplying heat to endless filaments passing thereover comprising an elongated, arcuate strip of conductive metal, said filaments passing over the convex side of said strip, a heating element attached to the concave side of said strip, a non-conducting housing, a pair of non-conducting blocks within and attached to the extremities of said housing, a springlike member extending between said blocks and arranged to mount said strip in said housing in yieldable relationship therewith, and extensions on said housing projecting outwardly at the edges and beyond the face of said strip.

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RICHARD M. WOOD, Primary Examiner.
R. F. STAUBLY, Assistant Examiner.