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[54] **APPARATUS FOR HEATING SYNTHETIC SUBSTANCE THREADS**
7 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **263/3,** 34/154

[51] **Int. Cl.** **F27b 9/28**
[50] **Field of Search** 263/3; 34/154; 57/34HS

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ABSTRACT: The heating element cells are constructed with double-tube sides to conduct the threads through the inner tubes while the heat carrier flows through the outer tubes. The heat carrier maintains the path of the threads within the double tube under a substantially uniform heat for substantially the entire passage.

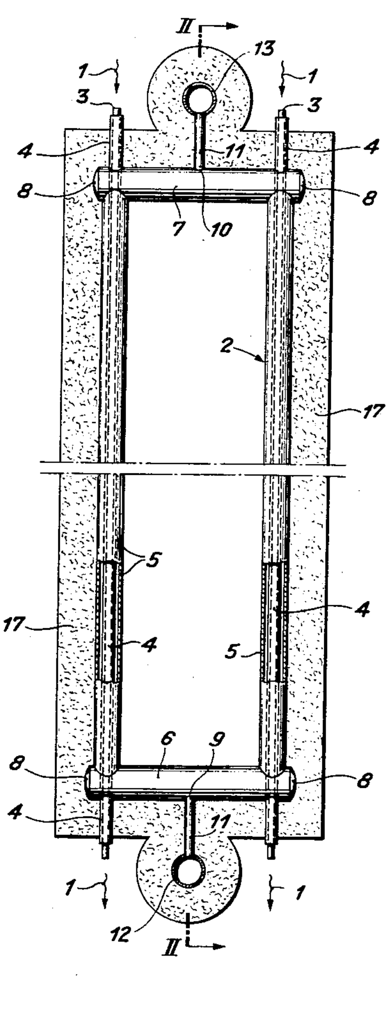

Fig. 1

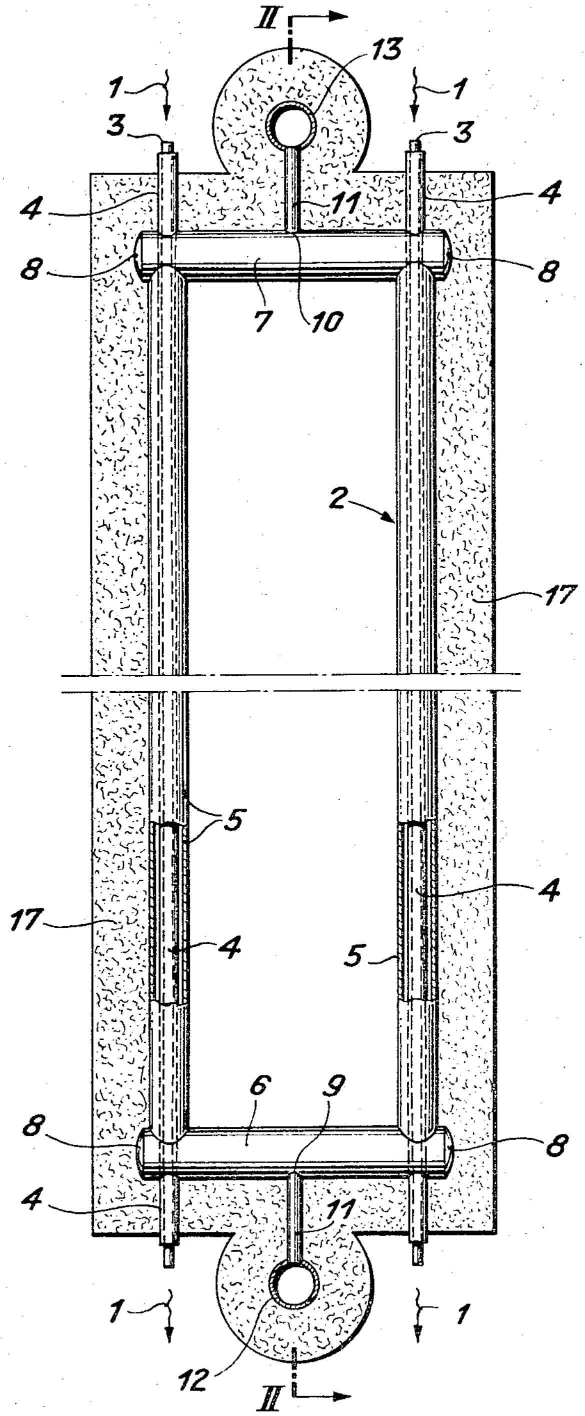

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Fig. 2

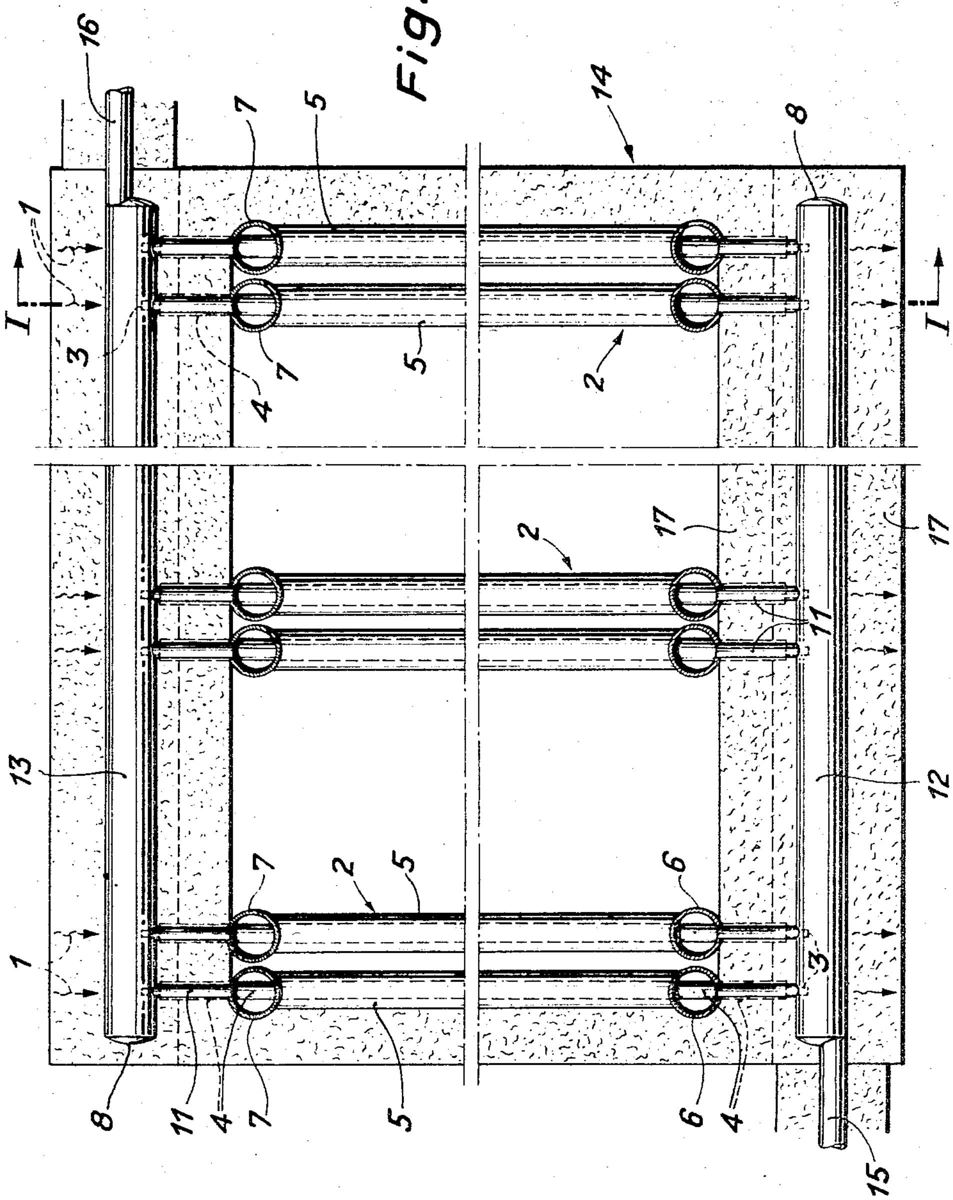

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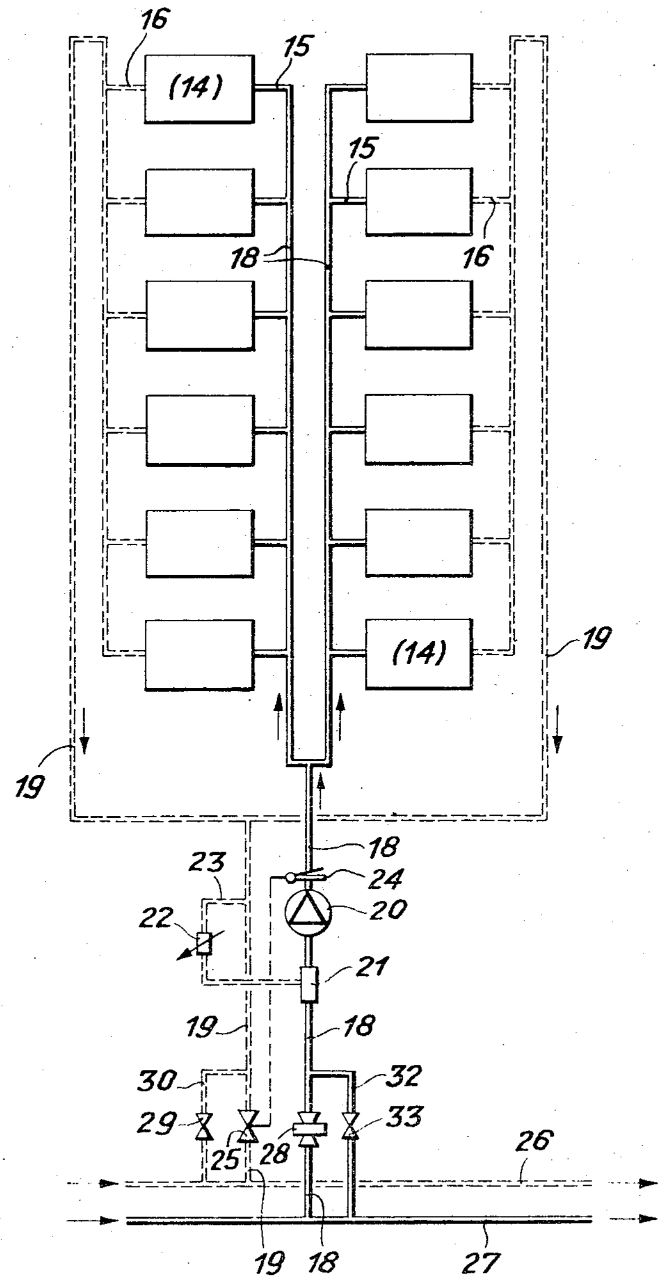
Fig. 3



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APPARATUS FOR HEATING SYNTHETIC SUBSTANCE THREADS

This invention relates to an apparatus for heating synthetic substance threads. More particularly, this invention relates to the use of a flowable heat carrier for heating synthetic threads in false-twisting machines.

Heretofore, in textile machines for curly yarn, such as false-twisting machines, heating devices have been used to heat synthetic threads to a temperature which permits twisting and setting of the thread during passage of the threads through the machines. Further, these heating devices have been constructed to maintain the thread at the temperature at which the thread becomes plastic. Usually, these heating devices through which the threads have run have been heated electrically. However, this often creates difficulties, particularly when the thread passes through at a relatively high speed. For example, one difficulty arises because it is difficult to hold the thread, which passes through relatively rapidly, for the necessary time at the necessary temperature, about 200° C., without making the heating device unallowably long in the direction of the This This is due to the fact that starting from the place or zone of maximum temperature, there is a relatively steep temperature gradient toward the thread inlet and thread outlet of the heating device.

Accordingly, it is an object of this invention, even in the case of machines with which the thread passes through the heating device at a relatively high speed, to achieve sufficiently high and uniform heating of synthetic threads for a sufficiently long period of time to efficiently twist the same.

It is another object of the invention to heat synthetic threads to a high temperature in a relatively small space.

It is another object of the invention to heat synthetic threads through the use of a flowable heat carrier.

It is another object of the invention to pass a thread through a uniformly heated passage.

Briefly, the invention provides an apparatus which can be attached to textile machines, such as false-twisters, for heating synthetic threads to predetermined temperatures. The apparatus utilizes a flowable heat carrier and a system of tubing wherein the threads can be substantially uniformly heated during passage therethrough.

The apparatus includes a plurality of framelike cells which are constructed with two longitudinal double-tube sides through each of which a thread runs in the interior space and a heat carrier flows in concentric relation in the surrounding space. In addition, each cell has a pair of transverse sides which connect with the outer tubes of each of the double-tube sides and through a connection containing a throttling means to a common distributor or common collector, respectively, for supplying and removing the heat carrier to and from the double-tube sides. The distributor and collector, in turn, are connected to a suitable heating means which serves to heat the heat carrier to the required temperature.

In one embodiment, the transverse sides of the cells are made as horizontal connecting tubular parts which extend beyond the ends of the double-tube sides and are closed at both ends, while the outer tubes of the double tubes are welded to the inside surfaces of the connecting tubular parts and the inner tubes of the double tubes pass through the connecting tubular parts and are welded to their outside surfaces. The particular advantage of this form of construction is that dead spaces in which impurities, air or water, may collect are avoided. This form of construction moreover ensures that when the heating apparatus is flushed out, the impurities can easily escape, and that during the filling of the system with the heat carrier neither water nor air collects in it.

It is moreover advantageous to surround each heating apparatus of a plurality of such which are secured to a textile machine and which are each composed of a plurality of cells, with its own insulation, and to fasten it in the textile machines by means of its associated distributor or collector conduit.

A number of heating apparatuses are generally disposed in a textile machine, and each of them contains, for example, 8 to 10 cells, heating some 16 to 20 threads. In order to uniformly heat all the threads in a machine it is therefore advantageous for each heating apparatus of this machine to be combined into a group in which, by means of an individual device, circulation of the heat carrier is maintained, whereby the temperature of the advancing heat carrier can be regulated individually for each group through a mixing-in of the return flow.

These and other objects and advantages of the invention will become more apparent from the following detailed description and appended claims taken in conjunction with the accompanying drawings in which:

FIG. 1 illustrates a view taken on line I–I of FIG. 2 of a framelike cell used in a heating apparatus according to the invention;

FIG. 2 illustrates a view taken on line II–II of FIG. 1 of a heating apparatus containing a plurality of framelike cells according to the invention; and

FIG. 3 schematically illustrates a construction of a plurality of heating apparatuses for a pair of textile machines with a circulation system for the heat carrier.

Referring to FIGS. 1 and 2, the heating apparatus is constructed as a heating element 14 which includes a plurality of framelike cells 2, for example, of rectangular shape, through each of which a pair of threads 1 run in a downward vertical direction. Each cell 2 is formed by a pair of vertically disposed double-tube sides formed by an inner tube 4 and a larger outer tube 4. The outer tube 5 surrounds the inner tube 4 with a slight clearance so that a heat carrier, for example, a synthetic high circulate oil, can circulate therebetween. The selection of this oil depends on the heating temperature desired. Because the vaporization point of the oil has to be higher than the temperature to which it is heated, it is desirable to select oils whose vaporization temperature lies within the range 330° to 350° C. Moreover, because the heat content of the oil is proportional to its specific weight and its specific heat it is desirable for the computed value of specific weight multiplied by specific heat to be high, so that only a small quantity of oil need be kept circulating.

In addition, because binding mediums become separated from the threads 1 during heating and deposit in the cooler zones of the heating apparatus, i.e. in the vicinity of the thread entry and thread exit, an inset tube 3, for example of aluminum, is fitted into each inner tube 4 of a double-tube side in order to convey the threads 1 and to pick up any materials deposited from the threads 1. The inset tubes 3 are fitted into the inner tubes 4 in a manner so that at the time of heating up and expansion, a good heat conducting connection is made therebetween and so that at intervals of time at which the tubes 3 become dirty they can be replaced.

Further, each cell 2 includes a pair of horizontally disposed connecting tubes 6, 7 which connect the upper and lower ends of the double-tube sides together. Each of the connecting tubes 6, 7 extends horizontally beyond the outer tubes 5 and are capped at each end by closure caps 8. Also, the outer tubes 5 are secured, as by welding, to the inside of the connecting tubes 6, 7 with respect to the cell configuration while the inner tubes 4 extend through the connecting tubes 6, 7 and are secured, as by welding, to the outside of the connecting tubes 6, 7 as shown.

Each connecting tube 6, 7 communicates with a tubular element 11 at the lowest and highest points, respectively, midway between the double-tube sides. The tubular element 11 of the lower connecting tube 6 further communicates with a distributor conduit 12 while the tubular element of the upper connecting tube 7 communicates with a collector conduit 13. In this way, the flowable heat carrier medium can be supplied from the distributor conduit 12 to the space between the tubes 4, 5 of the double-tube sides and removed via the collector conduit 13. Further, by constructing the connecting tubes 6, 7 with extended horizontal ends, by their connection with the tubes 4, 5 of the double-tube sides, and by the arrangement of the openings into the tubular elements 11 at the highest and lowest places, respectively, of the connection tubes 6 and 7, dead spaces are especially avoided in the system in which the heat carrying oil circulates, and in which, after the system is filled with the heat carrier, there might collect deposits of impurities, of water or air. Through this arrangement, with which there exist no pockets and recesses for foreign substances which might otherwise disturb uniform circulation of the heat carrier and a uniform transfer of heat from the heat carrier to the tubular elements, or which might produce steam hammering during the filling of the system, the oil preferably rises from the bottom to the top. Thus, the oil reaches all angles and corners and floats out any foreign substances, since in going from a horizontal to a vertical part of the cell **2**, and in going to the distributing and collecting conduits **12** and **13**, it is ensured that the transition places are always situated at the highest or lowest point of the horizontal part.

The tubular elements **11**, which are made as throttling tubes, or which may, however, also be made of wider tubes having throttling places therein ensure a uniform distribution of the heat carrier among the individual cells **2** of the heating element **14** (FIG. **2**), without special regulatory elements being required to ensure this. The great resistance to flow of the tubular elements **11** hereby ensures that at all branch-offs to the individual cells **2** of a heating element **14** uniformity of pressure shall prevail in the distributor conduit **12** and in the collector conduit **13**.

As is evident from FIG. **2**, the distributor conduit **12** and the collector conduit **13** extend over the entire length of the heating element, and consist of horizontal tubes which are closed at one end by a closure cap **8** and open at the other end into connection conduits **15** and **16** which lead to the forward flow and backward flow system **18, 19** (FIG. **3**) common to the complete machine. The conduits **15** and **16**, which are made as throttling tubes for the heating element **14**, are each connected eccentrically to the distributors and collectors **12** and **13**, respectively, in order to avoid any dead space.

Referring to FIG. **2**, the complete heating element **14** consists of a plurality of cells **2** connected in pairs to the same distributing and collecting conduit respectively, and is surrounded by a common high grade insulation **17**, for example, a mineral wool. The collector conduit **13** which is partly embedded in a layer of suitable insulation, can by means of holding devices (not shown) serve to fasten the individual heating elements **14** in the textile machine. Also, guide elements (not shown) can then be provided on the distributor conduit **12** to prevent the heating elements **14**, suspended in the textile machine, from swinging pendulum fashion.

The diagram of FIG. **3** shows by one example how a plurality of heating elements **14** belonging, for example, to two textile machines, can be combined into one group and can be connected to a main conduit system **26, 27** in which a source of heat (not shown) is disposed.

As shown, each heating element group forms a closed circulation system for the heat carrying oil wherein the oil is circulated by a pump **20** through the advance flow conduit **18**, the individual heating elements **14**, the return flow conduit **19**, and a mixing tube **21** that is installed in the advance flow conduit **18** through a branch line **23** having a check valve **22** disposed therein. The pump pressure in this system amounts, depending on the size of the system, for example to some 5 to 8 atmospheres gauge. The temperature of the inflow **18** is adjusted to a desired value by a temperature gauge **24** installed in the advance flow conduit **18**, for example, to a temperature of 220° C., in such a way that a relatively small partial quantity is carried away from the machine's circuit through a regulatory valve **25** installed in the return flow conduit **19** and controlled by the temperature gauge **24** and is fed into a return flow main conduit **26** which leads to a source of heat, a boiler for example (not shown). At the same time, an equal partial quantity is supplied anew into the machine's circuit from a feed conduit **27**, connected to the advance flow conduit **18** at a temperature of some 280° to 290° C., by way of a filter **28** and the mixing tube **21**. The regulatory valve **25** in the return flow line **18** is further bridged over by a bypass line **30** provided with a manual control valve **29** so that the system, in the event of some derangement or failure of its regulatory devices, can be maintained manually at the desired temperature. Another bypass line **32**, having a shut off valve on device **33**, can short circuit the filter **28**, to make it possible to clean the filter **28** from time to time during operation.

The pump **20** can suitably be a commercially obtainable rotary pump with slipring sealing, be cause such pumps lose very little through leakage. For the temperature gauge **24**, a bimetallic gauge may, for example, be used. Further, for purposes of regulation, it is advantageous to make use of electropneumatically controlled organs because they act relatively quickly, i.e. without much lag.

The circulation system of the machine's circuit is laid out in such a way that the quantity of oil circulated in unit time through the pump **20**, conduits **18**, heating elements **14**, conduits **19**, branch line **23** and mixing tube **21** is approximately 20 times the quantity flowing into and out of the feed conduit **27** and return flow conduit **26**. Moreover, the heat carrying oil should not differ more than 2° C. in temperature at its inflow into and outflow from the system.

As has already been mentioned, the selection of the heat carrier depends on the maximum temperature reached. Both the heating elements **14** and also all the inflow and outflow tubes connected to them should be made of suitable temperature withstanding tubes. For example, in the case of tubes for temperatures below 300° C., by tubes designated St. 35.29 should be used, and for temperatures from 300° to 400° C., by tubes marked St. 35.8 should be used.

The construction of the heating element **14** of individual framelike cells **2** with the double tubes **4, 5** through which the threads **1** run makes it possible to manage with a relatively small quantity of filled-in heat carrier. Furthermore, the long path for the threads **1**, situated between the connecting tubes **6** and **7**, ensures that the threads are kept at approximately the same temperature for their entire length passing through the tubes **4, 5** which has not been obtained with the arrangement available up to the present time. Through the installation of the throttling tubes **11** between the conduits **12** and **13**, respectively, uniform pressure distribution is ensured in the distributing and collecting conduits **12** and **13**, which ensures the individual cells **2** receiving equal quantities of heat, without being necessary to provide special regulatory elements for this.

I claim:

1. An apparatus for heating synthetic threads comprising:

at least one heating element having a plurality of framelike cells therein, each cell including a pair of vertical double-tube sides and a pair of transverse tubes, each double-tube side having an inner tube defining a passage for a thread and a concentric outer tube defining a concentric passage for a heat carrier about said inner tube and being connected at opposite ends to a respective transverse tube;

a pair of throttling tube means connected respectively to each said transverse tube for throttling a flow of heat carrier therethrough, one of said throttling tube means being connected to the lowermost side of the lower transverse tube and the other throttling tube means being connected to the highermost side of the upper transverse tube;

a common distributor connected to each throttling tube means of said lower transverse tubes for supplying the heat carrier uniformly to each cell; and

a common collector connected to each throttling tube means of said upper transverse tubes for removing the heat carrier from each cell.

2. An apparatus as set forth in claim **1** wherein said transverse tubes extend horizontally beyond each of said double-tube sides and wherein each said outer tube is secured to the inside of a respective transverse tube and each said inner tube passes through said transverse tube and is secured to the outside of said transverse tube.

3. An apparatus as set forth in claim **1** which further comprises insulation about said heating element.

4. An apparatus as set forth in claim 1 which comprises a plurality of said heating elements disposed in at least one group and a heat carrier circulation system connected to said heating elements of said group to circulate the heat carrier uniformly through said heating elements.

5. An apparatus as set forth in claim 4 wherein said circulation system includes means for mixing the outflow of heat carrier from each said collector with the supply of heat carrier to each said distribution to regulate the temperature of the heat carrier supplied to each group of heat elements.

6. An apparatus as set forth in claim 1 further comprising an inset tube removably fitted in each inner tube of said double-tube sides for depositing of thread impurities therein.

7. An apparatus as set forth in claim 1 further comprising means for supplying a heat carrier to said distributor including a conduit eccentrically connected axially to said distributor and means for removing the heat carrier from said collector including a conduit eccentrically connected axially to said collector.