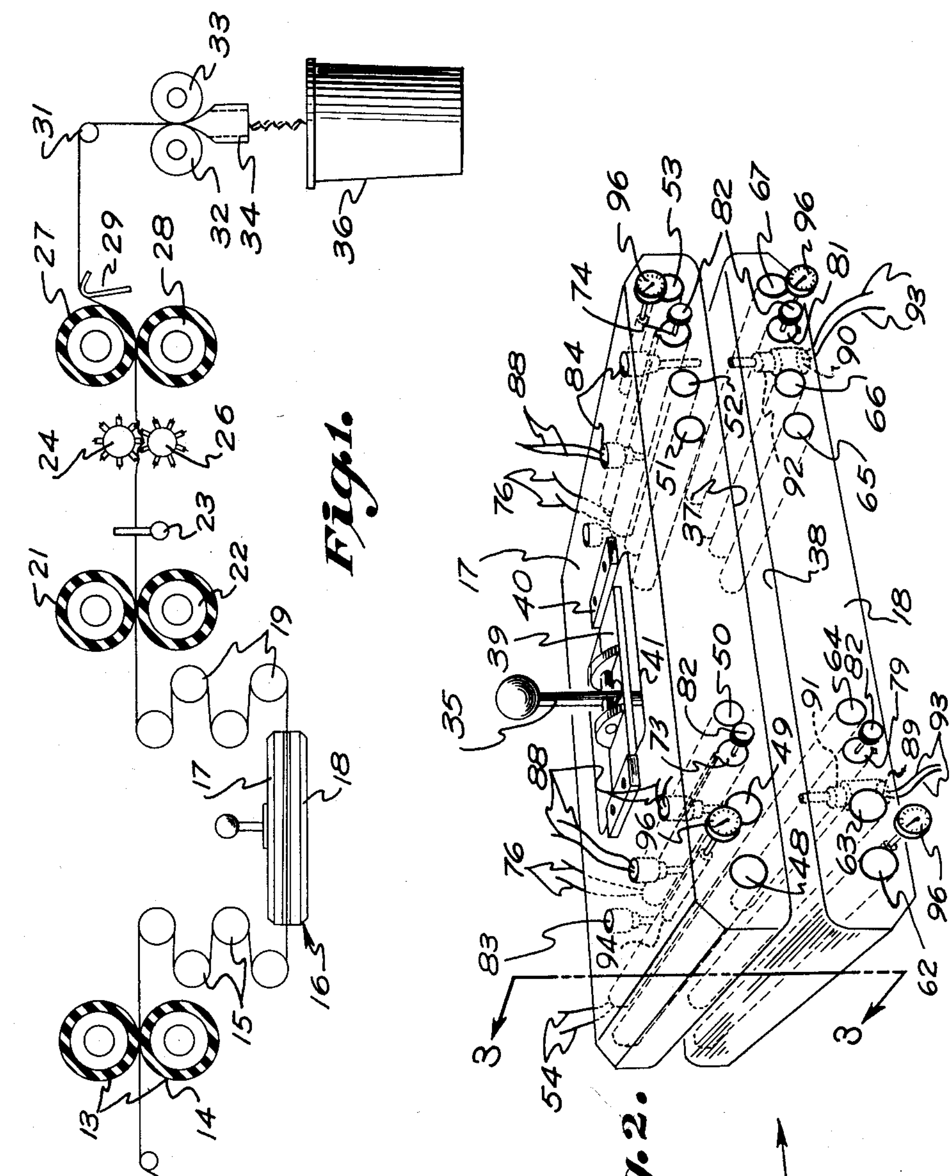
Jan. 5, 1960 L. V. JORGENSEN 2,920,176

HEATING DEVICE

Filed Oct. 28, 1957 2 Sheets-Sheet 1



INVENTOR.
LESTER V. JORGENSEN
BY Roy L. Wymbs
Russell Foster
ATTORNEYS

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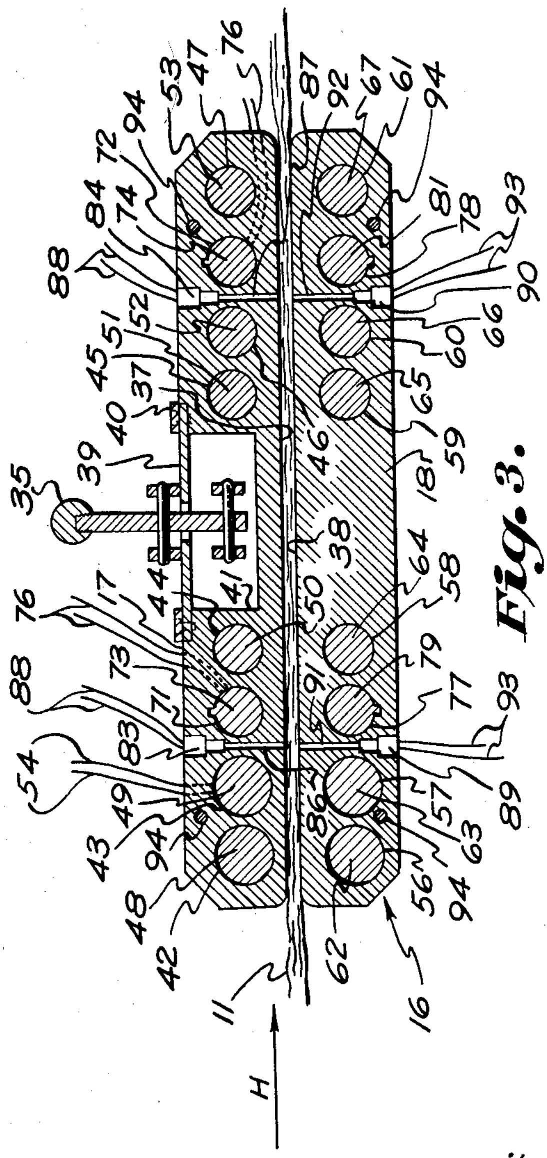

Fig. 3.

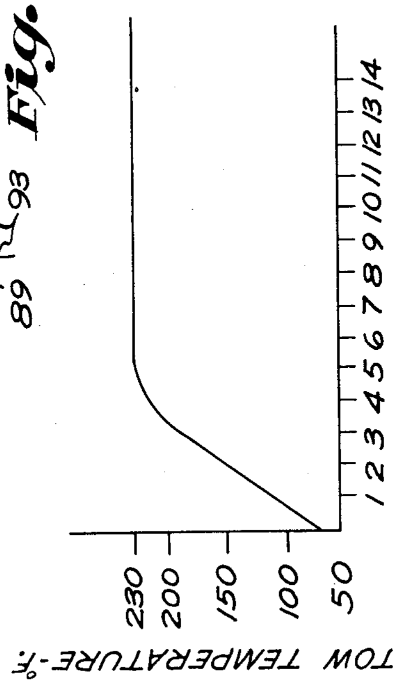

Fig. 4.

INVENTOR.
LESTER V. JORGENSEN
BY Roy P. Wymbs
T. Russell Foster
ATTORNEYS

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HEATING DEVICE

Lester V. Jorgensen, Decatur, Ala., assignor to The Chemstrand Corporation, Decatur, Ala., a corporation of Delaware

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This invention relates to an improvement in apparatus for treating filamentary material and more particularly to a device for supplying heat to a filamentary material containing filaments composed of a synthetic material such as that formed from acrylonitrile polymers and the like during a textile operation so as to bring the material to a predetermined state of plasticity and facilitate the stretching or drafting of the filaments in the material.

In many textile operations, particularly those operations where a continuous filamentary tow of synthetic material is treated, it is a common practice to stretch or elongate the filaments in the tow in order to impart certain desirable qualities to the filaments such as increasing their tensile strength. This stretching operation is generally carried out by applying heat to the filaments so as to raise their temperature to the level at which the tow is in a sufficiently plastic state to facilitate stretching. In one type of textile operation with which this invention is particularly concerned and which incorporates a heat-stretching step the operation is carried out on a tow of continuous filaments to convert the continuous filaments to fibers of relatively short length. A machine for carrying out this conversion operation is readily available commercially and is commonly known in the textile industry as a turboconverter or turbostapler. One such machine is shown in Patent No. 2,748,426, issued to W. K. Wyatt on June 5, 1956, and this invention is particularly directed to an improvement on this machine.

A turboconverter such as that described in the Wyatt patent incorporates a heat-stretching step during which the laterally spread filamentary tow advances between heated plates or platens which heat the filaments so that they can be stretched a predetermined amount between two pairs of nip rolls rotated at different speeds.

It was found in the processing of synthetic textile material, for example filaments formed from acrylonitrile polymers, that yarn processed in such a turboconverter was characterized by an excessive amount of relatively short lengths of filaments which were freely distributed in the yarn or what is known in the industry as "fly." This "fly" appeared in such quantities in fabric forming textile operations subsequent to conversion such as knitting as to greatly exceed the commercially acceptable limit. As is well known, when the "fly" is excessive in processed yarn, the fly which is not carried in the air and deposited on the apparatus to interfere with proper operation remains entwined in the fabric to give it an unsatisfactory surface appearance. Furthermore, the stretched tow did not emerge from between the platens in a substantially unbroken form as filament breakage appeared to occur to a large degree during the heat-stretching operation.

Subsequent investigation and study revealed the startling fact that the heat supplied to the tow and the temperature to which the tow was raised during application of heat were extremely critical and the construction and operation of the prior heating plates in the turboconverter was creating the unsatisfactory condition of excessive "fly" and filament breakage during heat-stretching. Temperature distribution throughout the plates was not uniformly controlled and cold spots were frequent, creating highly improper heating of a filamentary tow composed of the above materials.

Accordingly, a primary object of this invention is to provide a new and novel device for heating filamentary material so as to bring the filaments uniformly to a plastic state in which they may be readily stretched.

Another object of this invention is to provide a new and novel heating device for heating a tow of synthetic material comprising continuous textile filaments formed from acrylonitrile polymers and the like which enables the filaments to be brought quickly to a predetermind stretching temperature throughout an extended length of tow and which maintains such temperature within the continuously advancing tow so as to permit stretching of the filaments to be continuously accomplished in a highly satisfactory, substantially uniform manner.

A further object of this invention is to provide a new and improved heating device for the heat-stretching step in turboconverter apparatus of the type for converting continuous filament tow to staple fiber tow.

Still another object of this invention is to provide a new and novel heating device for supplying heat to filamentary tow formed from such synthetic material as acrylonitrile polymers which substantially reduces "fly" in the subsequent processing of yarn containing the heat-stretched filaments and which substantially eliminates filament breakage during the heat-stretching operation.

In the processing of filaments with a turboconverter of the above-described type, attempts to alter the results obtained in the end product by changing conditions such as platen temperature, tow advancing speed, and the like, gave widely diverse results which defied prediction. It is well known that synthetic materials such as those from which the above filaments were formed are very sensitive to heat transfer conditions and further difficulty was experienced with the limited control offered in the previous heating plates as the heating conditions at the plates could not be established with the degree of accuracy and pattern of temperature distribution necessary for the desired filament heat treatment. Furthermore, in the previous design of the heating platens, warping of the platens created a substantial lack of uniformity in platen spacing throughout the opposed heating surfaces particularly when the platens were hot, adding further to the lack of heat transfer control. Consequently, yarn physical characteristics could be controlled only to a very limited extent at best.

A still further object of this invention is to provide a new and novel heating device for facilitating the heat-stretching operation performed on filamentary tow which makes it possible to tailor the yarn end product physical character to the customer's specifications by changing the temperature at the heating device while maintaining the level of "fly" substantially below the commercially acceptable limit.

Still another object of this invention is to provide a new and improved heating device for facilitating the stretching of filamentary tow composed of synthetic material such as acrylonitrile polymers or the like which utilizes spaced heating platens, the spacing of which is maintained substantially uniform throughout under all conditions of temperature.

This invention further contemplates the provision of a new and improved heating device for facilitating the stretching of a filamentary tow formed from synthetic material such as acrylonitrile polymers or the like which is particularly adapted for use in the heat stretching section of a turboconverter or turbostapler to uniformly bring the continuously moving, laterally spread tow to any predetermined softening temperature selected in accordance with the yarn physical characteristics desired and maintain an extended length of tow in the heating device at such temperature so that filament stretching is accomplished in the desired manner with reduced filament breakage and a relatively low level of fly while producing an end product of accurately controlled physical characteristics.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawings.

In general, the objects of the invention are accomplished by providing a pair of substantially parallel platens each of which contains a heat transfer surface arranged in opposed relationship. A continuous rope or tow of filamentary material such as filaments formed from acrylonitrile polymers or the like is arranged to move between the opposed surfaces of the platens in heat transfer relationship therewith. The platens are heated internally by a plurality of heating means which extend substantially transverse or at 90 degrees to the direction of tow movement and heating means of predetermined capacity are spaced along the platens in the direction of tow movement so that the tow heating may be obtained in a predetermined pattern along the portion of the tow lying within the platens. Means are provided for sensing the temperature of the platen heating surfaces and for controlling the operation of the platen heating means so that relatively cold tow entering the platens is quickly brought to a predetermined stretching temperature and softened and a predetermined length of tow within the platens is maintained at this temperature during tow advance to permit stretching of the tow under conditions whereat fly is held to a low level.

The novel features which are believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation may be best understood by reference to the following description taken in conjunction with the accompanying drawing in which:

Figure 1 is a diagrammatic view of an apparatus for processing filamentary tow commonly referred to as a turboconverter of which this invention is an improvement;

Figure 2 is an enlarged perspective view of the heating device of the invention incorporated in the apparatus of Figure 1;

Figure 3 is a sectional view taken substantially along line 3—3 of Figure 2; and

Figure 4 is a typical graph of the temperature distribution along that portion of the filamentary tow extending within the heating device of Figure 2.

Referring now to Figure 1, there is shown diagrammatically an apparatus commonly referred to in the textile industry as a turboconverter or a turbostapler. As is well known, the turboconverter is employed to convert a bundle of continuous filaments to fibers of staple length with a breaking operation and may be of the type disclosed in the Patent No. 2,748,426 issued to W. K. Wyatt on June 5, 1956. Although the instant invention may be employed in a variety of textile applications, it represents in particular an improvement on a turboconverter of the type shown in the Wyatt patent and it will be described hereinafter as such.

As described in the above-mentioned patent, a filamentary tow **11** advancing through the apparatus initially threads between successive snubber bars **12** and enters a pair of rubber sheathed nip rolls **13, 14**. From the nip rolls **13, 14**, the tow **11** moves around a first set of auxiliary rolls **15** and travels through a heating device designated generally by the numeral **16** and comprising a pair of heated plates or platens **17, 18**. It should be understood that this invention lies in the specific construction of the heating device **16** and is therefore to be distinguished from the heating device of the Wyatt patent.

Leaving the platens **17, 18**, the tow **11** moves through a second set of auxiliary rolls **19** into a second pair of rubber sheathed nip rolls **21, 22**. As is well understood, the tow **11** is heated and softened during its passage between the platens **17, 18** and the nip rolls **21, 22** are operated at a faster speed than the nip rolls **13, 14** so that the softened tow **11** is stretched in any suitable ratio depending, of course, on the differential speed of the nip rolls **13, 14** and **21, 22**. For instance, a typical stretch ratio may be 1.5/1.

From the nip rolls **21, 22** the tow **11** advances through a tow guide **23** which controls the laterally spread tow and into break-up rolls **24, 26** from which it is carried by cooperating delivery nip rolls **27, 28** so that the continuous filaments are broken into fibers of staple length between the break-up and the delivery rolls. The tow then moves over guide plate **29** and around rod **31** into a pair of cooperating nip rolls **32, 33** which feed the tow into a crimping chamber or box **34** so that crimped staple tow is deposited into a receiver **36**.

In the processing of filamentary tow composed of heat sensitive synthetic material particularly synthetic material of the "acrylic" type, a turboconverter of the above-described type gives an end product which produces "fly" far above the permissible commercial limit and excessive filament breakage occurred in the heating device **16**. Study and experimentation led to the discovery that control of the temperature distribution and heat transfer conditions in the heating device were critical in the operation of the turboconverter when used for the processing of such material.

In accordance with the novel construction of the invention, means have been provided for supplying heat to the filamentary tow as it enters the heating device **16** to bring it quickly and uniformly to a predetermined softening temperature and maintain it at such a temperature during a substantial portion of its traverse through the heating device so as to facilitate stretching and reduce the "fly" produced to an absolute minimum.

More specifically, as shown in Figures 2, 3 the heating means **16** comprise a pair of platens **17, 18** which are supported in any suitable manner such as that shown in the above-mentioned patent with their opposed faces or heating surfaces **37, 38** in substantially parallel relationship. The platens **17, 18** are arranged to be moved by means of a suitable manually operable linkage between an open or widely spaced relationship to facilitate threading of the tow **11** therethrough to a closed position (Fig. 3) in which the tow advances through the platens in heat transfer contact with the surfaces **37, 38**.

In order to simplify the illustration of the invention the platen operating linkages are only partially shown but it should be understood that an operating handle **35** is suitably connected to the platens by means such as a swivel bracket **39** suitably secured to the platens by means of straps **40** as shown on the platen **17** in Figure 2. The platen **17** may be provided with a central recess **41** for accommodating a portion of the linkage connected to the platens. It should be understood that platens **17, 18** are substantially identical in construction except that they are of opposite hand and only platen **17**, hereinafter referred to as the "upper" platen, will be discussed in detail.

In order to insure that the heating surfaces **37, 38** are maintained in parallel relationship and eliminate warping of the platens, the platens **17, 18** are preferably composed of a material of high heat conductivity such as aluminum or magnesium. It can be understood that if the spacing between the surfaces **37, 38** is not uniform throughout the heating device **16**, heat transfer between the surfaces and the tow **11** will vary accordingly with attendant inaccuracies in the temperature control during the traverse of the tow through the heating device **16**.

As specifically illustrative of the novel construction of the invention, means have been provided for supplying heat to the platens **17**, **18** in order to bring the tow **11** quickly and uniformly to a predetermined stretching temperature. More specifically, the "upper" platen **17** is provided with a plurality of transversely extending bores **42** through **47** preferably cylindrical in shape which lie at substantially 90 degrees to the direction of tow movement as indicated by arrow H. Thus these cylindrical bores extend transversely in the heating device **16** and are spaced suitably as shown in Figures 2, 3 along the upper platen in the direction of tow movement. The bores **42** through **47** are arranged to accommodate heating means such as cylindrical unit heaters **48** through **53** respectively also preferably cylindrical in shape so as to be snugly accommodated within the bores. These heaters are arranged to be connected by means such as wires **54** to any conventional type of switching device (not shown) which enables the heaters to be connected to a suitable source of power.

It can be seen that with the unit heaters arranged in the novel manner of the invention so as to extend in a 90 degree direction to the movement of the tow, the tow will be heated uniformly throughout its lateral dimension. Thus inadequate heating or "cold spots" in the tow characteristic of prior heating devices, such as those with heaters extending in the direction of tow movement, are eliminated.

Although any number of unit heaters may be employed, in the illustrated embodiment such heaters are preferably six in number and are positioned within platen **17** in such a manner as to define two groups each arranged adjacent one end of the upper platen **17**. Similarly, platen **18** hereinafter referred to as the "lower" platen, is provided with transversely extending bores **56** through **61** arranged to accommodate unit heaters **62** through **67** as shown best in Figure 3.

As is well understood, the tow **11** prior to entering the heating device **16** is cold or in a virtually unheated state. Therefore, a substantial temperature differential exists between this initial tow temperature and the predetermined temperature to which the tow must be elevated for efficient stretching to be accomplished. Consequently, unit heaters **48**, **49** adjacent the end of the upper platen at which the tow enters and designated hereinafter as a "rear" end are of larger capacity than the remaining heaters and are accommodated within the transverse bores **42**, **43** respectively which are appropriately of large dimension as shown. Thus large quantities of heat are transferred to the tow immediately after it enters the heating device **16** to bring the tow quickly to the predetermined stretching temperature at which it is maintained by the subsequent heaters **50** through **53** spaced along the platen. Similarly, the "lower" platen **18** is provided with large capacity heaters **62**, **63**.

Although the unit heaters employed in the heating device **16** may be of any suitable heating capacity in accordance with the general requirements discussed above, in the specific embodiment illustrated heaters **48**, **49** are preferably approximately 750 watts capacity, heater **50** of approximately 400 watts capacity and heaters **51** through **53** with a heat output of approximately 350 watts. In the processing of acrylic filaments in the apparatus of Figure 1 it has been found in one type of such filaments that a stretching temperature of approximately 230 degrees F. gives satisfactory performance. Therefore, heat must be supplied to the cold tow **11** entering the heating device **16** so that the tow is quickly brought to the stretching temperature of 230 degrees F. and maintained at such temperature for a substantial length within the device in order to obtain the novel results accomplished by the invention. It should be understood, however, that although heaters of larger capacity are employed at the rear end of the heating device **16**, their output should be limited so as to preclude the scorching or burning of the tow. With the use of heaters of the capacity specified above, satisfactory heating of the tow is obtained for the processing of a wide variety of synthetic filamentary material as well as other material which responds to such a heating operation.

Referring now to Fig. 4 there is shown a graphical representation of one typical temperature distribution throughout the portion of the moving tow sandwiched between the heating platens **17**, **18**. For instance, when the platens are approximately 14 inches in length the tow is brought to the stretching temperature in a sufficiently short period of time so that approximately 10 inches of the tow sandwiched between the platens is maintained at the stretching temperature.

It can be seen that the tow **11** which enters the rear end of the heating device **16** at substantially room temperature is rapidly heated along the platen length and reaches the predetermined stretching temperature (230 degrees F.) at a distance of approximately 4 to 5 inches past the rear end of a 14 inch length plate with the portion of the tow extending throughout the remaining length of the platens being maintained at the stretching temperature. This tow heating arrangement is in accordance with one novel aspect of the invention as it was found that proper functioning of the heating device **16** so as to give an end product of desired characteristics required that the stretching temperature be maintained throughout this extended portion of the tow length sandwiched between the platens **17**, **18**.

It can be understood that in order to control the temperature of the heat transfer surfaces **37**, **38** on the platens **17**, **18**, the unit heaters **48** through **53** and **62** through **67** must be operated under closely controlled conditions in order to obtain the proper temperature distribution along the platens as indicated by the curve of Figure 4. As heat transfer between the surfaces **37**, **38** and the tow **11** depends in the main on the temperature differential between the surfaces and the tow, only a heating system which responds to surface temperature will give the heat transfer conditions necessary for the proper operation of the invention. Prior constructions have located the temperature sensing means remote from the heat transfer surfaces and consequently have given inaccurate readings.

Any suitable type of temperature sensing means may be provided for sensing the temperature of the surfaces **37**, **38** such as thermocouples or the like suitably spaced throughout the area of the surfaces which may be connected to suitable control devices for energizing the unit heaters in accordance with the heating requirements. However, in the specific embodiment, a somewhat simpler control and sensing system is utilized which has given satisfactory performance.

More specifically, the upper platen **17** is further provided with transverse bores **71**, **72** preferably cylindrical in shape each arranged adjacent opposite end of the upper platen **17** as shown in Figure 3. The bores **71**, **72** are arranged to snugly accommodate combined temperature sensing and control means **73**, **74** respectively, which are connected to the heater switching means (not shown) by means such as lead wires **76**. Similarly, the lower platen **18** is provided with bores **77**, **78** containing combined temperature sensing and control means **79**, **81** respectively. In the specific embodiment illustrated each of the temperature sensing and control means are connected for gang operation of the three unit heaters with which it is associated.

The combined temperature sensing and control means employed in the specific embodiment illustrated are therefore a commercially available type of controller which acts in response to the amount of heat flowing at its location in the platen to control the operation of the unit heaters through their associated switching means and maintain a predetermined temperature at the heat transfer surface under a particular set of tow advancing conditions such as tow speed, thickness and the like.

It should be understood that the controllers are manually adjustable by means such as control knobs **82** (Fig. 2). Therefore, the desired operating temperature at the heat transfer surface **37** for a particular set of tow advancing conditions may be obtained by means of a plurality of thermocouples **83, 84** positioned in wells **86, 87** respectively in the upper platen **17** adjacent each end of the platen. These thermocouples are connected for the purpose of initial heater control adjustment by means such as lead wires **88** to suitable temperature recording means (not shown). As shown in Figures 2, 3, the thermocouples at each end of the platen are arranged in rows of **3** extending transversely of the upper platen so as to given temperature readings at specific localities across the platen. The walls **86, 87** are of such depth as to position the heat sensitive tip of each thermocouple closely adjacent the heat transfer surface **37.** It has been found that a spacing of approximately 1/32 of an inch gives a satisfactorily accurate indication of surface temperature. Similarly, the lower platen **18** contains thermocouples **89, 90** positioned in wells **91, 92** which are connected by means of lead wires **93** to the temperature recording means.

Thus a predetermined surface temperature may be established across the platens at each bank of thermocouples by rotating the control knob of their associated controller to obtain the desired heater output for each set of tow running conditions. For example, with a tow speed of 82 feet per minute entering the platens a temperature reading of 362 degrees F. at the upper and lower thermocouples **83, 89** and a temperature of 398 degrees F. at upper and lower thermocouples **84, 90** gives a highly satisfactory heat-stretching performance for a stretch temperature of 210 degrees F. It should be understood that once the temperature setting is made by means of the controller no further reference to the thermocouples is necessary.

As previously discussed, other systems may be provided for controlling the temperature conditions at the platens heat transfer surfaces **37, 38** and the system described is merely one commercially acceptable arrangement due to its simplicity and low initial cost. It can be seen that the surface temperature setting at the two spaced points identified by the two spaced banks of themocouples on each platen are based on approximate temperature values in accordance with the spacing and capacity of the unit heaters but are sufficiently accurate to give the results indicated in the graph of Figure 4. Greater refinement may be made, however, if desired in the temperature control without departing from the scope of the invention. For instance, as previously discussed, each of the unit heaters may be individually controlled. Furthermore, the recess **41** may be omitted from the platen by the use of a different operating linkage and additional unit heaters may be added in this central location to alter the heating conditions in the device **16.**

If desired, transverse bores **94** may be provided in the platens adjacent each end for accommodating the stem of an indicating dial thermometer **96** (Fig. 2). By means of these thermometers **96** any unusual temperature change in the platens during operation such as might occur as a result of changing physical conditions or the like is readily visible to the operator as he need only refer to the thermometer dial for periodic checks of the running temperature conditions.

In the operation of the apparatus of Figure 1, the tow is advanced through the platens **17, 18** with the platens heat transfer surfaces **37, 38** in contact with each side of the laterally spread tow. As the tow, which is initially at or close to room temperature, moves through the heating device **16**, it is heated rapidly by the relatively large heaters at the rear end of the platens. This rapid heating quickly brings the tow to a softened condition at a predetermined stretching temperature and in a uniform manner as a result of the transversely extending position of the heaters. Furthermore, the tow has moved only a short distance into the heating device (approximtely 5 inches in the specific embodiment) before this stretching temperature is reached as shown in the graph of Figure 4. For instance, this stretching temperature may be approximately 230 degree F. and it is maintained along the remaining portion of the tow within the platens under the sensing and controlling action of the previously adjusted controllers **71, 72, 79** and **81.**

The transversely extending heaters maintain a substantially uniform temperature across the laterally spread tow to eliminate the highly undesirable cold spots common to previous constructions. As the nip rolls **21, 22** are rotated at a relatively faster speed than the nip rolls, **13, 14** in accordance with the stretch ratio desired, the tow emerges from the heating device **16** in the properly stretched condition and proceeds in the above described manner through the remaining elements of the apparatus of Figure 1.

It can be seen through the novel construction of the heating device **16** that the tow **11** may be brought quickly to a stretching temperature and maintained at such temperature for a sufficient length so that a suitable length of tow is softened for the stretching operation. Furthermore, softening is uniform laterally across the tow and stretching under such ideal conditions means yarn fly is held to a minimum and filament breakage within the heating device is materially reduced. Another outstanding feature of the invention is the control of the physical characteristics of tow processed in the associated apparatus afforded by the accurate stretching temperature control. For instance, it has been found that when the stretching temperature is increased yarn shrinkage is decreased proportionally and as greater stretch radios are permitted without affecting the amount of yarn fly, the tensile strength can be correspondingly increased at any given plate temperature. This extensive processing control means that filaments of highly sensitive synthetic material may now be processed and tailored to customer specification for any end fabric application.

While there has been described what at present is considered to be the preferred embodiment of the invention, it will be understood by those skilled in the art that various changes and modifications may be made therein without departing from the invention and therefore it is the aim of the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

Having thus described the invention, what is claimed is:

1. An improvement in apparatus for converting continuous filament tow into a tow of staple fiber comprising, in combination, a pair of spaced heating platens composed of a material of high heat conductivity, a heating surface on each of said platens, said platens arranged to be positioned with said heating surfaces in substantially parallel relationship, means to advance said tow through said platens in heat transfer relationship with said heating surfaces, a plurality of electrically operated heaters selectively spaced internally of said platens in the direction of tow movement with the axis of said heaters lying substantially at 90 degrees to said direction, said heaters adjacent the tow entrance end of said platens of relatively large capacity so as to bring said tow quickly to a predetermined stretching temperature, said heaters remote from said tow entrance end acting to maintain said tow at the stetching temperature throughout the major portion of its length within the platens, and means for controlling the energization of said heating means in accordance with the temperature of said heating surfaces.

2. An improvement in accordance with claim 1 wherein said platens are composed of aluminum.

3. An improvement in apparatus for converting con-

tinuous filament tow into a tow of staple fiber comprising, in combination, a pair of spaced heating platens composed of a material of high heat conductivity, a heating surface on each of said platens, said platens arranged to be positioned with said heating surfaces in substantially parallel relationship, means to advance said tow through said platens in heat transfer relationship with said heating surfaces, a plurality of electrically operated heaters selectively spaced internally of said platens in the direction of tow movement with the axis of said heaters lying substantially at 90° to said direction, said heaters being arranged in a longitudinally spaced bank adjacent each end of said platens with said bank adjacent the tow entrance end of said platens including heaters of relatively large capacity so as to bring said tow quickly to a predetermined stretching temperature, said heaters in the other bank acting to maintain said tow at a stretching temperature throughout the major portion of its length within the platens, means for controlling the energization of said heating means including a plurality of thermocouples spaced transversely of said platens adjacent each of said heater banks for sensing the temperature of said heating surfaces.

4. An improvement in accordance with claim 3 wherein said heaters are arranged in banks of three with said bank adjacent the tow entrance end of said platens including two heaters of relatively large capacity.

5. An improvement in apparatus for converting continuous filament tow into a tow of staple fiber comprising, in combination, a pair of spaced heating platens, a heating surface on each of said platens, said platens arranged to be positioned with said heating surfaces in substantial parallel relationship, means to advance said tow through said platens in heat transfer relationship with said heating surfaces, means associated with each of said platens for heating said surfaces, said heating means extending substantially 90 degrees to the direction of tow movement, and means for controlling the energization of said heating means in accordance with the temperature of said heating surfaces to supply heat at a predetermined rate to portions of said tow advancing through said platens and bring said tow to a stretching temperature, said means for controlling energization of said heating means being regulated to supply heat to said tow at a relatively greater rate adjacent the end of said platens at which said tow enters so as to maintain the tow at said stretching temperature throughout the major portion of its traverse through said platens.

6. An improvement in accordance with claim 5 wherein said platens are composed of aluminum.

7. An improvement in accordance with claim 3 wherein said platens are composed of aluminum.

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