April 4, 1961 C. G. EVANS ET AL 2,977,661

YARN ELASTICIZING APPARATUS

Filed Nov. 18, 1955 2 Sheets-Sheet 1

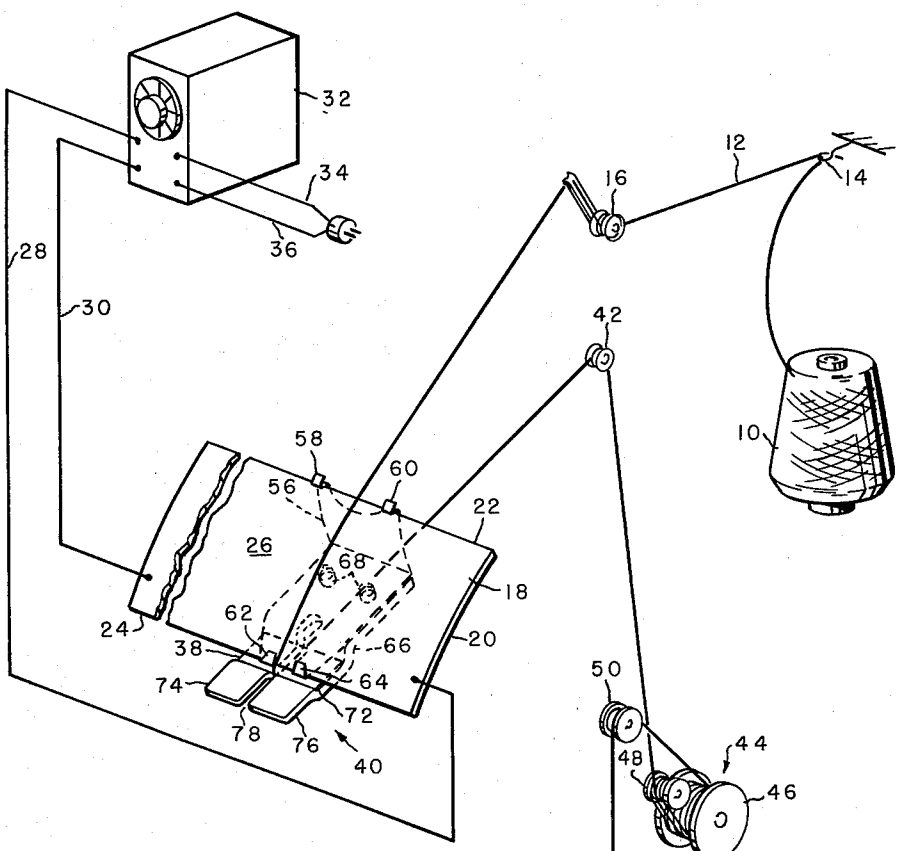


FIG. -1-

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YARN ELASTICIZING APPARATUS

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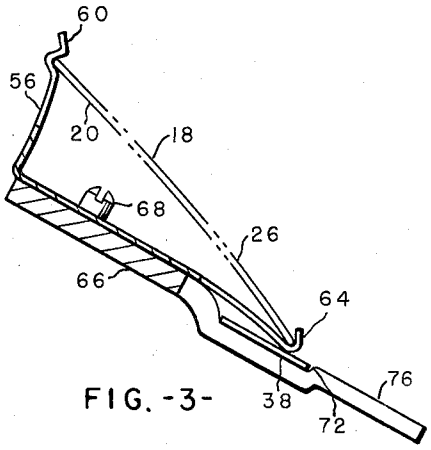


FIG. -3-

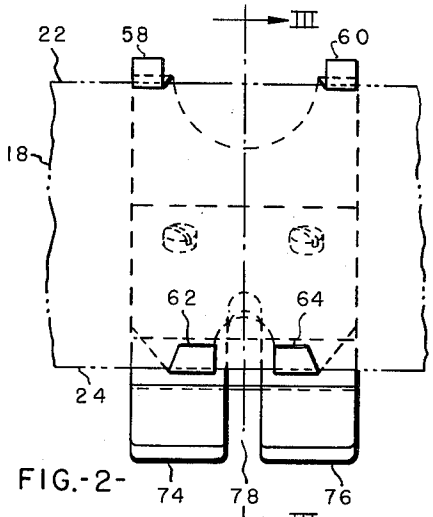


FIG. -2-

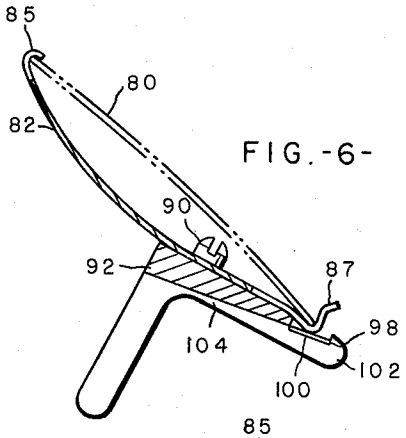


FIG. -6-

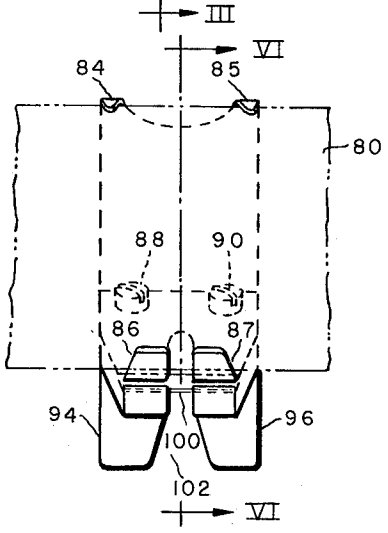


FIG. -4-

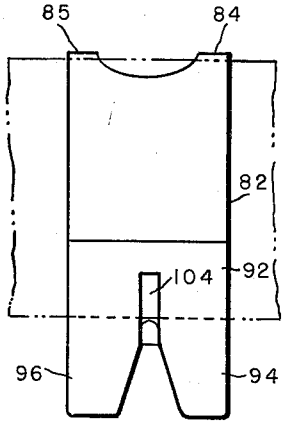


FIG. -5-

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YARN ELASTICIZING APPARATUS

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7 Claims. (Cl. 28—1)

This invention relates to improved yarn elasticizing processes of the type wherein an end of yarn under tension is conveyed through an angular path while at an elevated temperature, and to novel apparatus for practicing the improved processes.

It is now well known in the art that, under proper conditions, passing a thermoplastic yarn under tension through a linear path having a sharply angular portion will impart a generally permanent tendency to coil to the yarn if it is at an elevated temperature at the time it passes through the angular portion of the yarn path, and processes for elasticizing yarn in this manner constitute a part of the subject matter of U.S. application, S.N. 274,358, filed March 1, 1952. Such processes, as presently practiced and as described in the above mentioned U.S. application, comprise passing the yarn in an angular path about the edge of a blade member or the like with the blade edge positioned at the apex of the angle. The temperature of the yarn is raised to the desired level either by heating the blade and maintaining the same at an elevated temperature or by passing the yarn over a heater positioned in close proximity to the blade edge.

Prior to this invention it has generally been considered desirable in processes as above described, to retain the temperature of the yarn at least as nearly constant as possible during its passage through the angular portion of the yarn path or even to increase the temperature of the yarn during its passage through this portion of the path. The procedure of heating the blade about which the yarn is passed necessarily results in the temperature of the yarn being greatly increased during its passage through the angular portion of the yarn path, and even where a separate yarn heater is employed it has been conventional to place the blade in such close proximity to the heater that it is maintained at a temperature substantially equal to that of the yarn heating means. In such arrangements the blade edge acts as a supplemental yarn heating means to retain the yarn at substantially the same temperature as that to which it is heated by the primary yarn heating means.

Although it has previously been considered desirable to supply heat to the surface of the yarn in contact with the blade edge during such time that the yarn is passing through the angular portion of the yarn path, the possible importance of the temperature of the side of the yarn adjacent the blade edge relative to that of the side of the yarn removed from the blade edge has, as far as is known, not been previously considered. It will be apparent, however, that the methods of the prior art have generally resulted in a differential with the side of the yarn adjacent the blade edge being at a temperature at least slightly higher than that of the side of the yarn removed from the blade edge. Arrangements wherein the yarn is passed about the edge of a heated blade member have inherently resulted in a longitudinally extending portion of the yarn adjacent the blade being at an appreciably higher temperature than the opposite side of

the yarn, which is removed from the blade edge, because of the poor thermal conductivity of the yarn, and even in arrangements wherein the yarn is heated before it is passed around the blade edge, a portion of the yarn adjacent the blade edge has undoubtedly been at a somewhat higher temperature than the opposite side of the yarn since no effort has heretofore been made to cool the blade.

It has now been found that yarn having a higher degree of elasticity than has heretofore been attainable by a blade elasticizing method can be produced by positively exerting a cooling influence on the surface of the yarn in an area extending axially of the yarn at least through the angular portion of the yarn path and perimetrically through at least a substantial portion of the periphery of the yarn. Preferably the cooling conditions are such as to preferentially affect a longitudinally extending portion of the yarn on the inside of the angular portion of the yarn path and according to a preferred embodiment of the invention the cooling influence is provided by retaining a blade member, having an edge about which the yarn is passed, at a mean temperature below that conventionally employed so that the cooling effect is greatest upon the longitudinally extending portion of the yarn surface having a concave curvature axially of the yarn. A further advantage of this arrangement is that the yarn can be rapidly cooled following its passage through the angular portion of the yarn path by contact with one face of the cool blade and it has been found that this results in a further increase in the degree of elasticity imparted to the yarn.

While the exact reason or reasons for the success of the improved process are not fully understood, it seems probable that there are a number of factors involved. During the time a segment of the yarn is passing through the angular portion of the yarn path, the side of the yarn removed from the blade edge is under tension and is stretched relative to its condition at a point in the yarn path immediately preceding the angular portion of the yarn path. The opposite side of the yarn is, however, not stretched at this time and, in fact, is under compression. When the yarn segment is subsequently straightened, the stretched side is placed under compression and contracts a percentage of the length it has been stretched in passing through the angular portion of the yarn path. At approximately the same point in the yarn path that the side of the yarn removed from the blade is placed under compression, the opposite side of the yarn is placed under tension and stretched a slight degree relative to its length in the angular portion of the yarn path. The yarn is thereafter cooled with one side under tension and with the other side under compression. When one considers that lowering the temperature widens the creep recovery range and raises the elastic limit of the yarn, it can be seen, in view of the above discussion, that the stretching of the side of the yarn removed from the blade should be accomplished at a relatively high temperature, the stretching of the side of the yarn passed in contact with the blade edge should be accomplished at a relatively low temperature and the compressing and contracting of the side of the yarn removed from the blade edge should likewise be accomplished at a relatively low temperature. This would not only explain why improved results might be obtained by uniformly cooling the yarn while it is passing through the angular portion of the yarn path but might also explain why preferably the cooling of the yarn is effected preferentially on the side of the yarn passing adjacent the blade edge. It should not, however, be inferred from this explanation that the process necessarily results in a net elongation of the yarn being processed since generally the process results in the yarn increasing in denier, and

while the explanation appears to be most satisfactory at the present time, it should be emphasized that it is, to some extent, theory and applicants do not wish to be limited thereby.

Apparatus for performing the new process also constitutes a part of the present invention and broadly comprises means for passing a thermoplastic yarn under tension through a linear path having a sharply angular portion, means for heating the yarn so that it enters the angular portion of the yarn path at an elevated temperature and means for cooling the yarn during its passage through the angular portion of the yarn path. As previously mentioned, cooling of the yarn is preferably achieved by retaining a blade, over the edge of which the yarn is passed, at a temperature which is low relative to that of the yarn entering the angular portion of the yarn path and according to a preferred embodiment of the invention, there is provided a blade holding means, for securing a blade in fixed position relative to a yarn heating means, and means to operatively retain said blade at a mean temperature which is low relative to that of the yarn heating means and relative to that of the yarn as it enters into contact with the blade edge. The means for retaining the blade at a relatively low temperature preferably comprises a heat dissipating member, formed of a material having a relatively high thermal conductivity, against which the blade is forcefully urged so that heat is removed from the blade by conduction.

The blade holders constituting preferred forms of apparatus according to this invention provide an exceptionally advantageous means for operatively retaining the blade at a low temperature so that it exerts a cooling effect on the yarn while it is passing through the angular portion of the yarn path. In the first instance, the new blade holders are simple in design, have no moving parts, and do not require a forced circulation of cooling fluid. A forced circulation system for cooling the blade must at least include a motor, pump and conduits to transport the fluid so that it can be seen that apparatus which does not require such a system is highly advantageous.

Another advantage of the new blade holders is that no insulation is required to keep the blade at a relatively low temperature. The use of insulation not only results in a considerable time lag before the blade reaches its characteristic operating temperature but also requires that the blade be further removed from the yarn heating means than is generally considered to be desirable. With the preferred form of blade holder of this invention, the blade reaches its characteristic operating temperature rapidly and may be positioned extremely close to the yarn heating means if so desired.

Still another advantage of the new blade holders is that they permit blades in several units of yarn elasticizing apparatus to be retained at substantially the same temperature so that the yarn produced by the various units is of uniform quality and can be combined for the formation of a single piece of fabric. If the means selected for cooling the blade results in a blade in one unit of apparatus being at a substantially different temperature than that in another, the yarn produced by the two units may not be of uniform quality. If yarn from the two units is combined in the formation of a fabric, the difference in quality is frequently quite apparent and the fabric frequently does not have a uniform appearance. With the preferred form of blade holder of this invention, the amount of heat received by the blade under a given set of conditions is substantially constant from unit to unit because of the precise positioning of the blade with respect to the heater element, while the amount of heat removed from the blade under the same set of conditions is also substantially constant, and this results in the blades in the various units of the apparatus being at very nearly the same temperature so that yarn of uniform quality may be produced.

A further advantage of the new blade holders is that they provide a simple and efficient means for rapidly cooling the yarn after it has passed through the angular portion of the yarn path. With the preferred form of blade holder of this invention it is possible to pass the yarn in contact with one face of the blade immediately after it has passed around the blade edge and since the blade is at a relatively low temperature, this results in the yarn being cooled very rapidly.

Even without regard to their ability to retain the blade at a uniformly low temperature, the preferred forms of apparatus according to this invention have many advantages over the blade holders employed in prior art elasticizing apparatus. The type of holder most widely employed at present comprises a wire member bent to engage the ends of the blade and opposite faces of the heating element and while such a holder is relatively inexpensive, it has several inherent disadvantages. A first such disadvantage is that the wire holders of the prior art provide no positive means for aligning the blade relative to the heater element or relative to the yarn path, and any variation in alignment affects the yarn quality. For example, if the blade edge in one instance is further removed from the heater element than in another instance, the yarn cools to a greater extent in passing from the heater to the edge in the instance where the edge is at a greater distance from the heater element so that the yarn enters the angular portion of the yarn path at a lower temperature, and the yarn produced in the two instances is not of uniform quality. As another example, if the blade edge is skewed relative to the yarn path, it encourages the yarn to roll laterally over the edge so that false twist is inserted in the yarn and becomes heat-set therein due to the heated condition of the yarn. It can be seen, therefore, if in one instance the blade is at right angles to the yarn path while in another instance the blade is skewed relative to the yarn path, the yarn produced in the two instances will not be of equal quality. The preferred forms of apparatus of this invention overcome the above difficulties and make possible a precise positioning of the blade relative to the yarn heater.

Another disadvantage of the prior art holders is that they are easily deformed by bending and are extremely difficult to precisely reproduce. The preferred form of blade holder of this invention is seldom if ever deformed by careful handling and is even capable of standing a measure of abuse. Likewise this new form of blade holder may readily be reproduced with precision and it is a feature of one species, to be subsequently described in detail, that it can be produced solely by means of punch press operations and does not require even a single milling operation.

Still another disadvantage of prior art holders is that they are generally designed for one shape, thickness and size of blade so that if one wishes to employ a different type of blade from that for which the holder was designed, an entirely new holder becomes necessary. The preferred form of blade holder of this invention can, however, be employed with a wide range of blade types and sizes so that it is seldom necessary to have available more than one species of holder.

The invention will now be described in greater detail with reference to the accompanying drawings illustrating two preferred forms of apparatus and in which:

Figure 1 is a schematic view in perspective of yarn elasticizing apparatus according to this invention showing principal parts in location.

Figure 2 is an enlarged front plan view of the blade holding means shown in Figure 1 of the drawings.

Figure 3 is a cross sectional view taken along the line III, III of Figure 2 of the drawings.

Figure 4 is a front plan view of a modified form of blade holding means.

Figure 5 is a rear elevational view of the blade holder of Figure 4.

Figure 6 is a cross sectional view taken along the line VI, VI of Figure 4 of the drawings.

With particular reference to Figures 1 to 3 of the drawings there is illustrated a yarn supply means **10** mounted on a suitable frame or support member, not illustrated. A yarn end, indicated by the reference numeral **12**, passes from supply package **10** through a guide **14**, and to a tension regulating device indicated by the reference numeral **16**. The tension regulating device **16** serves to remove the fluctuations in tension resulting from the removal of the yarn from supply package **10** and to further tension the yarn **12**, while the guide **14** is to permit removal of the yarn from the yarn supply package in an over end manner.

From the tension regulator **16**, the yarn passes into contact with a yarn heater **18** which is illustrated as comprising a relatively narrow elongated plate or strip and which may be formed from any suitable material such as stainless steel. As illustrated, the heater strip **18** is provided with a back face **20**, a pair of opposed side surfaces **22** and **24**, and a yarn engaging upper surface or face **26** which is preferably convexly curved to a radius of from 4 to 10 inches so that continuous contact with the yarn is obtained. The heater strip **18** should be of sufficient width to result in an end of yarn drawn thereover being heated to the desired temperature and is preferably as thin as is consistent with the strength and rigidity required. It is adapted to be heated by means of an electric current passed therethrough and is connected by a pair of electric conductors **28** and **30** to a variable transformer **32** which is supplied with power from any suitable source, not illustrated, through leads **34** and **36**.

After passing over the face **26** of heater strip **18**, the yarn end **12** passes around the edge of the blade member **38** carried by a blade holding means **40** which will subsequently be described in greater detail. The yarn end is then passed in contact with the bottom face of the blade **38**, to a guide roller **42** and thereafter to a yarn feeding or transporting device, generally indicated by the reference numeral **44** and illustrated as comprising a pair of driven capstans or rolls **46** and **48**. The yarn passes one or more times about rolls **46** and **48**, about an idler roll **50** and thereafter through a guide **52** to a conventional yarn take up means **54** here illustrated as comprising a ring and spindle array. The yarn is then collected by the take up means **54** in the form of a conventional yarn package.

The blade holding means **40** comprises an elongated clip member **56** which may be formed of any resilient material such as spring steel and which extends across the back face **20** of heater strip **18**. The ends of clip member **56** are in each instance formed with an indentation of such shape as to result in ears **58**, **60**, **62** and **64** on each corner thereof which are shaped to engage opposite side surfaces **22** and **24** of the heater strip **18** and to precisely position the clip member **56** with respect to the heater element. An elongated heat dissipating member or plate, generally indicated by the reference numeral **66** is attached near one end by any suitable means such as screws **68** to a suitable support surface on clip member **56**. A portion of the plate **66** intermediate the two ends thereof is offset to form an indentation **72** immediately below one edge of the yarn engaging surface of the heater strip **18**. The degree of offset is such that the upper surface of the plate within the indentation **72** is displaced beyond the plane of the lower surface of the secured end of the plate or, in other words, the intermediate portion of the plate is offset an amount at least equal to the thickness of the plate.

The unsupported end of plate **66** is bifurcated to result in a pair of legs **74** and **76** separated by an open ended slot **78** which extends generally parallel to one side of the plate. The slot **78** should be of sufficient width to easily receive an end of the yarn to be processed and should be of sufficient length to extend at least through the intermediate offset portion of the plate **66** for reasons that will subsequently be seen. Legs **74** and **76** extend outwardly from under heater strip **18** into open convectional contact with the atmosphere and serve as cooling "fins" to dissipate heat from the entire blade assembly. The total surface area and the mass of the plate **66** are preferably large as compared to that of blade **38** so that the plate may more effectively serve as a heat dissipating means. For example, the mass of the plate should generally be at least about 4 to 10 times that of the blade and the total surface area of the plate should generally be at least about 2 to 5 times that of the blade. Also, the plate **66** is preferably formed of a material having a relatively high specific thermal conductivity, for example, above about 0.1 and preferably above about 0.3 calorie per second per degree centigrade, so that the temperature gradient in plate **66** is very small and heat is rapidly removed from the blade member **38**. The preferred materials, cost considered, for forming the plate **66** are aluminum and copper, or alloys of either of these two materials, because of the high thermal conductivity by which they are characterized. The distance that legs **74** and **76** extend from under the heater strip will depend upon a number of factors including the total surface area of the plate **66** and the amount of heat that must be dissipated but generally a distance of about ¼ to one inch will be sufficient.

The blade member **38**, which may be formed of any suitable material such as carbon spring steel or stainless steel, is positioned underneath, as viewed in the drawings, ears **62** and **64**, and rests within the indentation **72**. Clip member **56** is so formed that ears **62** and **64** extend into the indentation **72** and forcefully contact the bottom surface thereof, as viewed in the drawings, unless they are prevented from doing so by the presence of a blade. It will be seen, therefore, that when a blade is placed in proper position within identation **72**, it is pressed between ears **62** and **64** and plate **66**, because of the resilient nature of clip member **56**, and is separated from the heater element by a fixed distance as determined by the thickness of ears **62** and **64**. The minimum thickness of the ears **62** and **64** at the point of their contact with blade **38** is determined only by the requirement that the ears have sufficient strength to serve their intended function, although there is generally little or no advantage in making the ears less than about 2 to 5 thousandths of an inch thick at this point. On the other hand, if the ears **62** and **64** are made so thick that the upper surface of the blade is removed from the immediate proximity of the bottom or terminal edge of the yarn heating surface of the heater strip, this requires that the yarn travel a longer distance in passing from the heater to the blade edge and results in premature cooling of the yarn. To compensate for this cooling, the yarn must then be heated to a higher temperature by the heater strip than would otherwise be necessary and this might result in unnecessary yarn deterioration. As a general rule, the thickness of the ears **62** and **64** at the point of their contact with the upper face of the blade should be no more than about 200 to 500 times the diameter of the yarn to be processed and preferably no more than about 25 to 50 times the diameter of the yarn.

It will also be seen from the above discussion that the angle of the blade **38** with respect to a line tangent to the yarn engaging surface of the heater element adjacent its lower edge, as viewed in the drawings, will be determined by the angle which the support surface within the indentation makes with such a line. Since the distance between the point at which the plate is attached to clip member **56** is relatively large as compared to any reasonable thickness for the blade **38**, the blade **38** may vary in thickness within reansonably large limits without

appreciably varying the angle between the plane of the plate and the yarn path as represented by the above mentioned line tangent to the yarn engaging surface of the heater plate adjacent its lower edge as viewed in the drawings. For example, this angle for a blade which is 1/1000 of an inch thick and for a blade which is 9/1000 of an inch thick will generally vary less than a degree and this is insufficient to appreciably affect yarn uniformity. In fact, the angle may be varied as much as one or two degrees without any noticeable variation in the yarn produced so that even with this much variation from unit to unit of the yarn treating apparatus, the yarn produced by the various units is not so different in nature that it cannot readily be combined in the formation of a fabric. This angle is not otherwise extremely critical and as long as all blades are at substantially the same angle to the yarn path, the angle may be varied within wide limits without resulting in unsatisfactory yarn. For example, the angle may be as much as 90 degrees or more and may be as small as 10 degrees or less. With other factors being equal, it is a general rule that the smaller the angle, the higher the degree of elasticity obtained but when the angle is made very small, it becomes increasingly difficult to retain the plate **66** at a low temperature because of its overall nearness to the heater element. Generally best results can be obtained when the clip member **56** is so formed that the angle between the plane of the blade and a line tangent to the yarn engaging surface of the heater element adjacent its lower edge as viewed in the drawings is from about 20 to 40 degrees.

The width of the blade is relatively unimportant, so long as it is sufficiently narrow to be accommodated within indentation **72**, since the blade is properly positioned by abutment of the yarn engaging edge thereof against the forward, as viewed in the drawings, boundary surface of the indentation **72**. Likewise, the length of the blade is unimportant so long as it is of sufficient length to extend across slot **78**, but it is generally advantageous to employ a relatively long blade so that as one point on the yarn engaging edge becomes worn, the blade can be moved lengthwise within indentation **72** to position a new section of the blade edge within the yarn path.

The blade member **38** should generally extend outwardly beyond the heater element to the extent that the yarn engaging edge intersects a line tangent to the yarn engaging surface **26** of the heater element adjacent the lower edge thereof as viewed in the drawings. This results in the most satisfactory yarn path since the yarn remains in contact with the heater element to the termination of the yarn engaging surface and yet is not bent at the point when it leaves the surface. This means that the yarn path approaches the yarn engaging edge of the blade at the minimum possible angle with the blade at any given angle to a line tangent to the yarn engaging surface of the heater element adjacent the lower edge thereof. The above statement, relative to the distance that the blade extends beyond the heater strip, applies, however, only when the heater strip is sufficiently thin that the blade edge is not too far removed from the heater when positioned in the manner described. The blade edge should ordinarily not be at a distance greater than about 300 to 600 times the diameter of the yarn being processed from the yarn engaging surface of the heater element, and, if necessary, it is generally advantageous to sacrifice a small approach angle in order to keep the distance of the heater from the blade edge below this upper limit.

It will be apparent to those skilled in the art that apparatus of the type described can readily be constructed by modification of a conventional spinning or twister frame. In either instance all that need be added is the yarn heating means including heater strip **18**, blade holding means **40**, tension regulator **16** and guide means, in some instances, to provide a proper yarn path. In the case of a twister frame, the rolls **46** and **48** can constitute the conventional yarn feed means and in the case of a spinning frame, the feed means can constitute the delivery pair of the drawing rolls. It will also be apparent that a single heater strip of considerable length can serve a multiplicity of blades spaced at intervals corresponding to each position of the frame, although in such an arrangement it is usually desirable for the heater strip to be insulated between the various positions to reduce the heat loss.

In operation, an end of yarn from supply package **10** is threaded through the apparatus in the manner previously described so that it is in contact with the upper yarn engaging surface of heater strip **18** between the ears **58** and **60** and between the ears **62** and **64**, passes through slot **78** about the yarn engaging edge of blade member **38** and thereafter passes across the lower surface of the blade member. Since the depth of the indentation **72** is greater than the thickness of plate **66** and since slot **78** extends at least through the offset portion of the plate **66**, it will be seen that the yarn at no time need contact any surface of the blade holding means if the yarn is properly centered within slot **78** as it passes around the blade edge. This eliminates the necessity of highly polishing or hardening any of the surfaces of the blade holder and permits the tension in the yarn to be maintained at a minimum value.

Once the apparatus is properly threaded, the heater strip **18** is brought to a proper temperature by adjustment of transformer **32**, and even though the heater strip becomes quite hot, blade **38** is retained at a relatively low temperature since it is not in direct contact with the heater element and has a large surface area in contact with plate **66**. When the heater strip is at a proper operating temperature, the feed means **44** and collecting means **54** are placed in operation, so that the yarn is drawn through the yarn path at a proper operating linear velocity, and thereafter the tension in the yarn should be checked and regulator **16** adjusted to give a proper value if such is found to be necessary. Proper operating limits for yarn velocity, yarn tension, and heater element temperature, as well as limits for other variables such as the radius of curvature of the blade edge and yarn size, are conventional and are essentially as given in the above mentioned copending United States application, Serial Number 274,358. They will, therefore, not be discussed in detail in this specification.

After the apparatus is in operation, periodic checks should be made on the blade temperature to make certain that sufficient cooling is achieved. The cooling action necessary for best results will vary with the linear rate of movement of the yarn through the yarn path, since if the linear velocity of the yarn is very high, the yarn is in contact with the blade edge for a shorter time than it would be with a lower linear rate of movement. Therefore, to reduce the temperature of the surface of the yarn, during its contact with the blade edge, a specified number of degrees below the value at which it would be with no cooling of the blade, the temperature of the blade at the point of contact with the yarn should be lower at higher yarn velocities. Also, since yarn moving at a high velocity will transfer a large amount of heat to the blade edge, it may be necessary that the mean temperature of the blade be considerably below the temperature of the blade at the point where it is in contact with the yarn and for these reasons a very cool blade is generally necessary for best results when the yarn velocity is very high. On the other hand, if the blade is at a very low temperature and the yarn velocity is very slow, it is possible that the yarn might be thoroughly cooled below an operative temperature before the yarn has passed through the angular portion of the yarn path. As a general rule, the benefits of the process of this invention are obtained, at least to some extent, if the ratio of the yarn velocity, in yards per minute, to the difference, in degrees F., between the mean temperature

of the blade and the temperature of the yarn on contact with the blade, or of the temperature of the heater element if the arrangement is such that the yarn can be considered to be at approximately the temperature of the heater, is from about 3.0 to 0.05, although the ratio should preferably have a value of from about 0.8 to 0.1. For example, with nylon yarn, which is conventionally processed at a temperature of from about 280 to 340° F., and with conventional yarn velocities of from about 30 to 80 yards per minute, the mean temperature of the blade is preferably from about 60 to 160° F. If, on checking the temperature of the blade, it is found to be too high by the above standards, either the yarn velocity should be reduced, or a blade holding means with greater cooling action should be substituted for the one being employed.

With reference to Figures 4 to 6 of the drawings there is illustrated a heater strip **80**, similar to that described in connection with the previous drawings, and extending across the back surface of the heater strip is a clip member generally indicated by the reference numeral **82**. The clip member **82** is provided with ears **84**, **85**, **86** and **87** for engaging opposite side surfaces of the heater strip **80** and for precisely positioning the clip **82** with respect to the heater element.

Secured to the clip member **82** by any suitable means such as screws **88** and **90** is an angular heat dissipating member generally indicated by the reference numeral **92**. Member **92** is made of a material having a relatively high thermal conductivity and is provided with a pair of depending leg members **94** and **96** extending generally away from heater element **80** into open convective contact with the atmosphere. Leg members **94** and **96** serve the same purposes as legs **74** and **76** in the embodiment previously described.

The heat dissipating member **92** extends beyond one side surface of heater element **80** and is provided with an upwardly facing indentation **98** immediately below the side surface of the heater element as viewed in the drawings. Indentation **98** is of sufficient width to hold a blade member **100**, which can be generally similar or identical to that previously described in connection with Figures 1 to 3 of the drawings, and provides a recessed support surface against which the blade is operatively positioned. The support surface within indentation **98** should be parallel to the plane of the blade when the blade is at the desired angle with respect to a line tangent to the yarn engaging surface of the heater element **80** adjacent the lower edge thereof as viewed in the drawings while the upper surface of member **92** is preferably at a slightly smaller angle with respect to a similar line for reasons that will subsequently be made clear.

Heat dissipating member **92** is provided with a slot, indicated by the reference numeral **102**, which extends from the forward edge of the heat dissipating member, generally perpendicular to the longitudinal axis of blade **100**, at least through the indentation **98** to thereby provide a yarn path around the yarn engaging edge of the blade **100**. The heat dissipating member **92** is also provided with a groove **104** extending from between leg members **94** and **96** to the slot **102**. The base of groove **104** should be generally parallel to the plane of blade **100** and the groove should be of sufficient depth that an end of yarn drawn across the lower face of the blade **100** can be passed lengthwise of the groove without touching the boundary surfaces thereof. Since the support surface within indentation **98** is at an angle to the plane of the upper surface of member **92**, it will be seen that groove **104** may be of less depth toward the rear of member **92**, as viewed in the drawings, thereby providing a greater thickness of material above the rear part of the groove for increased strength.

Ears **86** and **87** extend into indentation **98** and are normally in forceful contact with the bottom surface thereof, in the absence of a blade, due to the resiliency of clip member **82**. When a blade member is inserted between ears **86** and **87** and the floor of indentation **98**, it is forcefully urged against the heat dissipating member while being retained a fixed distance, equal to the thickness of ears **86** and **87**, from the heater element. As in the embodiment previously described, proper alignment of the blade is assured by abutment of its edge against the forward side surface of the indentation **98**.

Operation of the embodiment illustrated in Figures 4 to 6 is generally similar to that of the embodiment previously described. An end of yarn is drawn over the heater element **80** between ears **84** and **85** and between ears **86** and **87**. The yarn is then passed through slot **102** into contact with the yarn engaging edge of blade member **100**, across the lower surface of the blade and between legs **94** and **96** while within groove **104**. The yarn need not contact any surface on the blade holding means and, as in the previous embodiment, the blade member can readily be shifted to present a new portion to the yarn without disturbing the alignment of the blade.

Having thus described our invention what we desire to claim and secure by Letters Patent is:

1. In a yarn processing apparatus including an elongated heater strip having a yarn engaging surface, a blade member having a yarn engaging edge positioned in close proximity to one edge of said yarn engaging surface and yarn transporting means for continually drawing an end of yarn under tension into effective relationship with said heater strip and thereafter about said yarn engaging edge, improved blade holding means comprising heat dissipating means formed of a material with a high specific thermal conductivity and having a mass which is large as compared to the mass of said blade, said heat dissipating means having an indentation to receive said blade and said heat dissipating means having at least one member extending from the immediate proximity of said heater strip to thereby remove heat from said blade, clip means carried by said heat disspating means for engaging opposite sides of said heater strip and to thereby retain said heat dissipating means in fixed positional relationship with respect to said heater strip, at least one portion of said clip means acting to urge said blade against said heat dissipating means and to retain the same fixedly positioned in said indentation.

2. A device for holding a blade member in fixed and predetermined positional relationship to an arcuate heater strip in a yarn elasticizing apparatus, said device comprising in combination a clip member adapted to engage opposite sides of said heater strip, said clip member, when operatively positioned, presenting a support surface at a predetermined angle with respect to a line tangent to the yarn engaging surface of said heater strip adjacent one edge thereof, and a bifurcated, thermally conductive plate carried by said clip member in contact with said support surface, the legs of said bifurcated member extending from the immediate proximity of said heater strip into open convective contact with the atmosphere, each of said legs having an offset portion to form an indentation in the surface of said plate facing said heater strip when said clip member is operatively positioned, the degree of offset being such that the surface of said plate within the indentation is displaced beyond the plane of the surface, remote from the heater strip, of the undeformed portion of said plate, and said clip member being so formed that one end thereof extends into said indentation and urges a blade member positioned therein into contact with said plate.

3. A device for holding a blade member in a fixed positional relationship to a heater element having a yarn engaging face, a back face opposed to said yarn engaging face and a pair of opposed side surfaces, said device comprising in combination a clip member adapted to extend across said back face and to engage the opposed side surfaces of said heater element, a thermally conductive, heat dissipating plate member secured to said clip member and extending, when the clip member is in operative posi-

tion, outwardly beyond one boundary of said back face in close proximity to one of the side surfaces of the heater element, said plate member having one portion which is offset relative to adjacent portions of the plate to thereby form an indentation for receiving a blade and to thereby facilitate proper positioning of the blade by abutment of the edge thereof against one boundary surface of the indentation, said one portion of the plate being offset relative to the secured portion of said plate an amount at least equal to the thickness of the plate and said plate having an opening therein extending across said one portion thereof so that an end of yarn can be drawn across said heater strip, about the edge of the blade and across one face of the blade without being brought into contact with the blade holding means, and a contact surface carried by said clip member to hold said blade in forceful contact with said plate member, whereby it is retained in a proper operating position with respect to said heater element, is out of direct contact with said heater element and is normally at a temperature less than that of the heater element.

4. The combination according to claim 3 wherein said clip member is an elongated member with bifuracted ends adapted to engage opposite edges of the heater strip on either side of the yarn path in each instance.

5. A device for holding a blade member in fixed positional relationship to an elongated heater element having a yarn engaging face, a back face opposed to said yarn engaging face and a pair of opposed side surfaces, said device comprising in combination a clip member adapted to extend across said back face and to engage the opposite side surfaces of said heater element, a rectangular thermally conducting heat dissipating plate member secured to said clip member by one end with the other end thereof extending, when the clip member is in operative position, outwardly beyond one boundary of said back face into open convective contact with the atmosphere, said plate member having a portion intermediate the two ends thereof offset relative to adjacent portions of the plate to thereby form an indentation for receiving a blade, one boundary surface of said indentation extending generally parallel to said one side surface of the heater strip to serve as an abutment against which the blade edge may be pressed for proper positioning relative to said heater strip, said intermediate portion of the plate being offset relative to the secured end of said plate an amount at least equal to the thickness of the plate, and said plate having a slot at least of sufficient width to receive an end of yarn extending from the unsecured end of the plate at least through the intermediate offset portion thereof so that an end of yarn can be drawn across said heater strip, about the blade edge and thereafter across one face of the blade without being brought into contact with the blade holding means, and a contact surface carried by said clip member to hold said blade in forceful contact with said plate member whereby said blade is retained in proper operating position out of direct contact with said heater element and is normally at a temperature less than that of the heater element.

6. In a yarn elasticizing apparatus including a heater element, a blade member having a yarn engaging edge positioned in close proximity to but separated from said heater element and means for drawing an end of yarn under tension into effective relationship with said heater element and thereafter about said edge, improved blade holding means comprising a metallic heat dissipating member formed from a material having a specific thermal conductivity above about 0.3 calorie per second per degree for rapidly removing heat from said blade member, means for securing said blade in contact with said heat dissipating member and means for supporting said heat dissipating member in predetermined positional relationship with respect to said heater element.

7. In a yarn elasticizing apparatus including a heater element, a blade member having a yarn engaging edge positioned in close proximity to but separated from said heater element and means for drawing an end of yarn under tension into effective relationship with said heater element and thereafter about said edge, improved blade holding means comprising a metallic heat dissipating member formed from a material having a specific thermal conductivity above about 0.3 calorie per second per degree for rapidly removing heat from said blade member, means for securing said blade in contact with said heat dissipating member and means for supporting said heat dissipating member in predetermined positional relationship with respect to said heater element so that said yarn end can pass over said blade without contacting any surface of said blade holding means.

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