This invention relates to improvements in article stringing machines such as that disclosed in application for United States Letters Patent Serial No. 117,219, filed June 15, 1961, in the names of Charles P. Cardani et al., now Patent No. 3,142,896, and more particularly to strand controlling and manipulating devices especially useful in such machines.

In the method of the application a strand is threaded through either a single article or a pair of articles by means of an eye pointed needle and the leading end of the strand having been bulged by retraction of the needle is gripped by a pick before the needle is withdrawn to its starting position. During the withdrawal of the needle, after it has cleared the first-penetrated article, a quantity of strand is measured by being reeled through the eye of the needle to be available for the formation of a closed loop and the strand is thereafter gripped by a second picker between the needle eye and the article. The strand is then cut in advance of the needle eye leaving a length extending beyond the needle eye to form a bulge to be gripped by the first picker during the next operating cycle of the machine.

The reliable operation of the machine of the application necessitates that the length of the strand extending beyond the needle eye be maintained until the free end is under the complete control of the first picker. Maximum utility of the machine requires that the quantity of measured strand and the corresponding size of the closed loop remain uniform regardless of changing frictional characteristics of the material being operated upon and that a wide variety of strand material be usable in the machine without being unduly weakened by partial severing or abrasion.

It is accordingly an object of the present invention to improve the manipulation of the strand of article stringing machines.

It is another object to enhance the uniformity of strand measurement and corresponding loop size in such machines.

A more particular object is to improve the reliability of operation of article stringing machines by assuring the formation of a bulge in the needle thread to be gripped and controlled before the quantity of strand is measured.

Another object is to avoid weakening or partial cutting of the strand during the operation of the machine.

Yet another object is to adapt article stringing machines to a greater variety of article and strand characteristics than have hitherto been possible.

In the achievement of the foregoing objects and in accordance with a feature of the invention, a strand measuring drum is positioned between a pair of spaced apart stations in which articles to be connected together in pairs by a closed loop are received. The drum is provided at its periphery with a strand engaging pin and is oscillated by mechanism to store a quantity of strand which determines the size of the closed loop.

The control device connected with the strand measuring drum are control instrumentalties which engage the strand and are effective during successive portions of the machine cycle. One of these control devices, according to another feature of the invention, is embodied in a pivoted block which is spring loaded and rides over the point of the needle to engage the leading end of the thread extending beyond the needle eye so that the leading end is not withdrawn or shortened to such an extent that the strand will fail to bulge and thus contribute to a missed cycle of the machine.

In accordance with a further feature of the invention, the machine includes a rigid guide member through which the needle passes in penetrating the articles to be strung. Openings in the guide member not only control the strand during measuring but also assist in guiding the needle and in minimizing damage to the article being strung.

The foregoing objects and features will be more fully appreciated from the following detailed description of an illustrative embodiment of the invention taken in connection with the accompanying drawings in which:

FIG. 1 is a view in left side elevation of a machine according to the present invention;

FIG. 2 is a detail view, partly in section of an adjustable connection included in strand measuring apparatus of the machine along the line II—II of FIG. 1;

FIG. 3 is a detail view in perspective of a strand control block included in the machine;

FIG. 4 is a fragmentary view on an enlarged scale and in perspective showing strand manipulating devices of the machine;

FIG. 5 is a view in front elevation and partially in cross section showing the devices of FIG. 4 and a needle guide upon which is supported a unidirectional strand friction;

FIG. 6 is a detail view taken along the line VI—VI of FIG. 5;

FIG. 7 is an enlarged detail view showing the needle point penetrating an article;

FIG. 8 is a greatly enlarged fragmentary view of a portion of a strand measuring drum;

FIG. 9 is an enlarged detail view of the point of the needle;

FIG. 10 is a detail view on a large scale illustrating the needle and strand passing through a guide aperture;

FIG. 11 is a fragmentary view in front elevation showing the mode of strand measurement in the present machine; and

FIG. 12 is a view similar to FIG. 11 but showing more fully devices of the machine at the time that the leading end of the strand is being gripped by a picker.

Referring to FIGS. 1 and 12, the present machine is similar to the machine of the above-identified application in that it includes eyeleting devices comprising a main frame 10 formed with a forwardly extending base plate 12 upon which is supported an eyeleting spindle 14. Mounted above the eyeleting spindle 14 is a vertically reciprocated eyeleting tool 16 and a raceway 18 for feeding eyelets to be clinched securing together the ends of a length of strand which has previously been passed through one or a pair of articles in order to form a closed loop connected to the article or articles.

Mounted on the frame 10 is a housing 20 in which is journaled a shaft 22 driven through one revolution during each operating cycle of the machine. In addition to the elements already mentioned the general organization of the machine also includes clamps 24 and 26 on the left and right side of the eyeleting spindle as seen from the front of the machine for holding articles in stringing position. Also included in the present machine and performing the same function as in the machine of the application are a first pick 28 and a second picker 30 shown in FIG. 11 and a curved eye pointed needle 32, for penetrating articles to be strung, carrying the leading end of a strand 36. Cooperating with the needle 32 and the pickers 28 and 30 is a strand severing device 38 operating in the present machine in the same manner as in the machine of the application.
The needle 32 is clamped on a needle sector 40 and passes through a needle guide 42 having a wear resistant bushing 43 (FIG. 5) which stiffens the needle against deflection as it begins to penetrate an article. The machine is represented as operating upon a pair of shoes 44, 46 being connected together and to a tag 48 (FIG. 12) by a closed loop for purposes of self-service retail merchandising, for example. It will be appreciated, however, that the instant machine, like that of the application, is adapted for operating upon a wide variety of articles to be sold either singly or in pairs and in which a tag carrying such information as design and price may advantageously be connected by means of a flexible strand. The needle sector 40 is formed integral with a shaft 50 and a pinion 52 engaged by a gear segment 54 which receives oscillating motion from a cam mounted on the shaft 22 to actuate the needle for penetrating the articles and for retracting to a completely withdrawn position shown in FIG. 11. As the needle descends toward the shoe 46 the needle guide, urged away from the needle sector 40 by a torsion spring 56 wound concentrically with the shaft 50 as shown in FIG. 12, also moves with the needle until the guide butts against a stop 58 at a point where the guide has completed its needle stiffening function and the needle sector is then free to continue moving relatively closer to the guide 42 until the point of maximum needle penetration is reached. Having fully penetrated to the extent shown in dashed lines at the extreme left of FIG. 12, the needle is retracted to the solid line position of FIG. 12 causing the strand to bulge away from the needle as indicated at 60. The bulge 60 is thereafter gripped by the pincer 28 before the needle is fully withdrawn from the work to the position of FIG. 11.

The present improvements relate to devices which cooperate with those already described in the manipulation of the strand 36 to assure greater reliability of operation than has heretofore been possible. It is necessary that the bulge 60 be formed if the leading end of the strand is to be gripped by the pincher 28. Failure of the pincher 28 to grip the leading end of the strand results in a completely missed operating cycle, that is a machine cycle during which the strand is withdrawn from the article with the needle and no loop passing through the article is formed. In order to avoid shortening of the leading end portion of the strand lying beyond the needle eye as the needle penetrates the work the leading end is controlled by devices one of which includes a drag 66 also shown in FIGS. 3 to 5 inclusive.

The drag 66 is pivoted on a shoulder screw 68 threaded into a subframe 70 which is fixedly secured to the base plate. A tension spring 72 is stretched between an upwardly extending projection on the drag 66 and an anchor point on the subframe to urge the drag in a counterclockwise direction. Under the bias of the spring the drag 66 is arrested by an inner surface of a U-shaped guide member generally indicated at 74 and fixedly supported on the subframe. As the needle 32 begin to penetrate the shoe 46 it engages the drag 66 which is displaced in a clockwise direction to allow the needle to pass.

After the eye of the needle has advanced, the drag 66 frictionally engages the leading end of the strand to prevent unthreading of the needle. In the absence of the drag 66, particularly when operating upon highly resilient materials which present friction against the needle, there is a tendency for that portion of the strand below the needle which is engaged by both articles as seen in FIG. 5, to remain stationary as the needle advances thereby causing the leading end beyond the needle eye which is restrained by a single article to be shorn to such an extent that bulge 60 becomes unrealizable and occasionally the leading end is completely withdrawn from the needle eye, necessitating stoppage or retreading.

Associated with the drag 66 in controlling the needle strand is the guide member 74 which also assists, as will be later explained, in minimizing puncture damage to articles. As seen in FIGS. 4 and 5 the guide member 74 is formed with a first aperture 76 having a narrow land 78 contoured to direct the needle and strand and enlarged in the direction of needle penetration to minimize restraint of the needle to provide a smoothly forming in which the strand flows in being measured. The guide member 74 is also formed with a second aperture 80 having a land 82 and a flare for orienting the needle in the event that it is appreciably deflected by engaging a particular article. This flare provides assurance that the needle in an intense frictional grip at the aperture 76 as will be explained. Both lands 78 and 82 are contoured in the preferred form of the guide member 74 to provide a clearance space of uniform width about the cross section of the needle and strand. This land contour affords optimum control of needle and strand but is subject to limitations in the character of the material being operated upon and of manufacturing tolerances not only of the guide member 74 but also of the needle and strand. Accordingly, apertures 76 and 80 may be circular and of sufficient diameter to allow free passage of the thread with the needle which is affording the degree of control of the illustrated form. A slot 83 is cut from the outside of the member 74 to each of the apertures 76, 80 through which slots the strand is passed in removing articles from the machine after the article stringing operation is completed.

As seen in FIGS. 9 and 10 the needle 32 is formed on the outside with a deep groove 84 and on the inside with a short relatively shallow groove 85. The grooves 84 and 85 are provided to permit partial seating of the strand in the needle but inside groove 85 is shallower so that the leading end of the strand is more firmly engaged by the article being penetrated than the remainder of the strand disposed in the outside groove 84. This tighter engagement of the leading end of the strand by the articles and the larger portion of strand cross section engaged by the drag 66 cooperate to prevent withdrawal of the leading end of the strand through the eye of the needle.

In order to avoid a harsh reaving action of the strand through the needle eye during strand measurement which will be described, the needle eye is formed, as seen in FIG. 5, with a pair of relatively large radii 86 over which the strand passes when the needle is approximately in the position shown in FIG. 11. It will be noted particularly from FIG. 9 that the point of the needle is of pyramidal shape for ease of penetration of articles and at the same time to afford a degree of control over the material displaced by the passage of the needle. As seen in FIG. 7 the needle 32 in penetrating the shoe 46 cuts the shoe generally along the lines of intersection of the planes of the pyramid and in penetrating presses petals 88 forwardly in the direction of motion of the needle. Since the petals 88 enter the aperture 76 and surround the needle the clearance between the land 78 and the needle must be sufficient to accommodate the thickest material to be operated upon in order to prevent compacting the petals which in an extreme case may so tightly grip the needle as to cause severe deflection and even breakage. On the other hand if the clearance is excessive, the needle may not be adequately guided and the size of puncture in the shoe 46 may be undesirably increased. Under such conditions the guide member 74 may readily be exchanged when a different gage needle is to be employed or for operating upon thicker or thinner articles. The exchange of the guide member 74 is readily accomplished by simply removing a pair of screws 89 which secure the member 74 to the frame 70.

For measuring the length of strand to be employed in forming the closed loop connected to one or more articles there is rotateably supported in the subframe 70 a drum 90 into the periphery of which is press a replaceable pin
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92 extending outwardly and forwardly in the direction of measuring motion. The subframe 70 is formed with side plates 94 and 96 (FIG. 9) and the subframe and between which the drum is rotatably received. The plate 94 is perforated at 97 to permit the escape of lint and other particles and the plate 96 is counterbored and cut away to provide clearance for a pinion 98 rigidly connected to the drum and for a gear sector 100 which engages the pinion. The sector 100 is pivoted at 102 (FIG. 1) and a rearwardly extending arm of the sector is pivotally connected at 104 to the lower end of a pair of generally vertical spaced-apart link rods 106. At their upper ends the link rods 106 have an adjustable connective with the rearwardly extending arm of a generally horizontal actuating lever 108 pivoted on the housing 20 at 110. The forward end of the actuating lever 108 carries a follower roll 112 urged by a tension spring 113 into engagement with the contour of a cam 114 on the shaft 22 which causes the actuating lever to be oscillated once during each operating cycle of the machine.

The rearward extending arm of the lever 108 is formed with an arcuate slot through which passes a pivot bolt 116. Interposed between the lever 108 and the link bars 106 are wear washers 118 and providing a free fit between the bars and the lever are head bushings 120 which surround the pivot bolt 116 and are loosely fitted in cylindrical openings in the link bars. A tapped hole and knob 122 engages threads on the bolt 116 to clamp the bolt in place when it has been properly positioned to provide the required amount of strand positioning. Positioning the bolt 116 close to the pivot 110 causes minimum motion of the drum 90 and accordingly provides a length of strand just sufficient for the formation of a loop passing through a pair of articles such as the shoes 44, 46 and sufficient clearance for ease of removal of the machine.

On the other hand, placement of the bolt 116 at the opposite extreme of the slot of the lever 108 yields sufficient strand so that the closed loop passing through the shoes 44, 46 allows as much as ten inches of separation between the connected shoes.

The strand measuring apparatus already described greatly improves the performance of the present machine by eliminating components tending to weaken the strand by abrasion, partial holding or the application of excessive localized stresses. The width of the drum 90 and the diameter of the pin 92 are such, in the very limited available space, that there is no contact between the inside surfaces of the plates 94, 96 and a strand of maximum usable gage. At the same time the pin 92 is of sufficient diameter that even strands composed of stiff fibers such as nylon and "Dacron," for example, conform to its strand engaging surface without displacing or causing the loss of fibers. The present arrangement also avoids sharp edges over which the strand is drawn and further avoids conditions which produce sharp edges in the path of the strand as the machine wears.

To assist the instrumentalties already described in controlling the flow of the strand 36 there is also provided on the needle guide 42 a unidirectional friction 126 in the form of an X-shaped leaf spring perforated for passage of the needle and the strand and secured to the forward face of the needle guide by a single screw 128 threaded into the needle guide and passing through a slot in the friction to permit adjustment. The lower end surface of the needle guide is formed with a shallow groove 130 for directing the strand into the needle groove 54, and also into engagement with the laterally extending arm of the friction 126. Since the friction 126 is mounted in spaced relation with the forward face of the needle guide it is free to pivot slightly about the retaining screw 128 in either direction. The friction 126 is drawn toward the needle guide and into tighter engagement with the strand as the latter tends to pull away from the needle eye and is thus effective for preventing unthreading of the needle. The grip of the friction 126 is thus effective for preventing unthreading of the needle as the needle starts its motion from the position shown in FIG. 11 to the fully penetrated position of FIG. 12. The friction 126 is adapted to allow free passage of the strand as the needle eye continues in motion after the needle guide has come to rest against the stop 58 and later in the machine cycle the movement of the strand is relatively unhampered by the friction during strand measurement.

In the operation of the machine, after a pair of articles such as the shoes 44, 46 has been gripped by the clamps 24, 26, the machine is driven through a complete automatic cycle to pass the leading end of the strand 36 through the shoes and to form a closed loop connecting the shoes as more fully described in the already identified Cardani application. The ends of the loop are brought together and secured by means of an eyelet clinched on the spindle 14 as in the machine of the Cardani application.

As the needle 32 begins to penetrate the shoe 46, petals 88 are pushed forward into the aperture 76 and assist in guiding the needle. The point of the needle next engages the drag 66 which rides over the needle point and bears upon the leading end of the strand to assist in preventing withdrawal of the strand from the needle eye. During the initial part of the needle motion, before the shoe 46 is penetrated, the needle guide 42 accompanies the needle in essentially the same relationship as is shown in FIG. 11. However, after the guide 42 is engaged by the stop 58 the needle continues in motion, drawing the strand with little resistance through the friction 126. The leading end of the strand is gripped by the pincer 28 and the needle is withdrawn to the position of FIG. 11. As the needle point is withdrawn from the shoe 46 the drum 90 is driven in a clockwise direction, as seen in FIGS. 1 and 8, and then the pin 92 engages the strand which extends in its path between the apertures 76 and 80 in the guide member 74. During continued movement of the drum in the clockwise direction the strand is reaved through the needle eye and is little impeded by the friction 126 which has as one of its main functions preventing the needle from being drawn away from a stationary strand and thus being unthreaded before it begins to penetrate the shoe 46. At the end of its measuring stroke the direction of movement of the drum 90 is reversed and it is returned to the position shown in FIGS. 1, 4 and 5. During the return motion of the drum the strand is gripped by the pincer 30 and then cut by the severing device, leaving a sufficient length of strand extending beyond the needle eye for the next operation of the machine. The pincers 28 and 30 both describe orbits about the spindle 14 to form bights which are joined by a clamped eyelet as in the Cardani machine.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a machine for stringing together pairs of articles including means defining spaced-apart stringing positions for the articles, an eye-pointed needle, means for actuating the needle to penetrate the articles carrying the leading end of a strand therethrough and to withdraw from the articles, means for gripping the leading end of the strand after the articles have been penetrated and before withdrawal of the needle, and a movable needle guide for stiffening the needle during cycle penetration, the combination of unidirectional friction means including a leaf spring on the needle guide arranged to restrict strand movement away from the needle eye, a drag for engaging the leading end of the strand between the articles, a strand measuring drum between the articles, means for oscillating the drum to measure and to be connected to the articles and stationary guide means including a guide member for directing the needle during article penetration and for directing the movement of the strand.

2. In a machine for stringing together pairs of articles including means defining spaced-apart stringing positions...
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for the articles, an eye-pointed needle, means for actuating the needle to penetrate the articles carrying the leading end of a strand therethrough and to withdraw from the articles and means for gripping the leading end of the strand after the articles have been penetrated and before withdrawal of the needle, the combination of stationary guide means including a guide member formed with spaced apart apertures through which the needle passes during article penetration and between which the strand extends upon withdrawal of the needle, a rotatably supported drum, a strand engaging pin on the drum and means for oscillating the drum to cause the pin to engage the strand between the apertures to measure the length of strand to be connected to the articles.

3. In a machine for stringing together pairs of articles including means defining spaced-apart stringing positions for the articles, an eye-pointed needle, means for actuating the needle to penetrate the articles carrying the leading end of the strand after the articles have been penetrated and before withdrawal of the needle, the combination of stationary guide means including a guide member formed with spaced-apart apertures through which the needle passes during article penetration and between which the strand extends upon withdrawal of the needle, a drag between the apertures adapted to engage the leading end of the strand to prevent unthreading of the needle during article penetration, a rotatably supported drum, a strand engaging pin on the drum and means for oscillating the drum to cause the strand between the apertures to measure the length of strand to be connected to the articles.

4. In an article stringing machine, including an eye-pointed needle, means for actuating the needle to pass the leading end of a strand from a supply through an article and to retract from the article, and a needle guide mounted for movement with the needle toward the article, the combination of stationary needle guiding means including a block formed with a flared opening loosely fitting the needle and strand and also formed with an exit slot for the strand connected to the article, said means including a pivoted drag for frictionally engaging the leading end of the strand extending beyond the needle eye as the needle begins to penetrate the article.

5. In an article stringing machine including a frame, means for clamping an article in stringing position, an eye-pointed needle, means for actuating the needle to pass the leading end of a strand from a supply through the article and to retract from the article, means for gripping the leading end of the strand before the needle is retracted, a second gripping means for seizing the strand between the article and the eye of the retracted needle and means for thereafter severing the strand between the needle eye and the second gripping means, a strand measuring device comprising a drum rotatable in the frame, a pin extending outwardly from the periphery of the drum and means for oscillating the drum to withdraw a quantity of strand stored by being laid on the periphery of the drum as the drum is moved in one direction and released as the movement of the drum is reversed to supply a predetermined length of strand to be severed by the severing means.

6. In an article stringing machine including an eye-pointed needle, means for actuating the needle to pass the leading end of a strand from a supply through an article and to retract from the article, and a needle guide spring biased for movement with the needle toward the article at the beginning of needle movement toward the article, the combination of stationary needle guiding means including a block formed with a flared opening loosely fitting the needle and strand and also formed with an exit slot for the strand connected to the article, means including a pivoted drag for frictionally engaging the leading end of the strand extending beyond the needle eye as the needle begins to penetrate the article and, on the needle guide, a unidirectional thread friction for engaging the strand to restrict movement of the strand toward the supply.

7. A strand measuring device comprising a rotatable drum, strand engaging means on the drum and means for oscillating the drum from a starting angular position to store a quantity of strand laid on the drum by the action of the strand engaging means as the drum is moved in one direction and to free the strand as the drum is returned to its starting position.

8. Strand measuring apparatus comprising a pair of spaced apart strand directing means, a rotatable drum between the strand directing means, strand engaging means on the drum and means for oscillating the drum during an operating cycle to store a quantity of strand laid on the drum by the action of the strand engaging means as the drum is moved in one direction from a starting position and to free the strand as the drum is returned to its starting position.

9. In an article stringing machine the combination of a needle reinforcing guide, a curved eye-pointed needle formed with an outside groove for receiving a portion of strand between the needle eye and a supply of strand and with an inside groove shallower than the outside groove for receiving the leading end of the strand extending beyond the needle eye whereby the leading end is more tightly engaged by an article being penetrated than is that portion of the strand received in the outside groove, and means on the needle guide for directing the strand from the supply into the outside groove.

10. In an article stringing machine the combination of a needle reinforcing guide, a curved eye-pointed needle having a pyramid-shaped point and formed with an outside groove for receiving a portion of strand between the needle eye and a supply of strand and with an inside groove shallower than the outside groove for receiving the leading end of the strand extending beyond the needle eye whereby the leading end is more tightly engaged in passing through a puncture formed by the needle point in an article than is that portion of the strand received in the inside groove, and means on the needle guide for directing the strand from the supply into the outside groove.

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