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B. L. POWERS ET AL
YARN STRETCHING DEVICE

2,962,793

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3 Sheets-Sheet 1

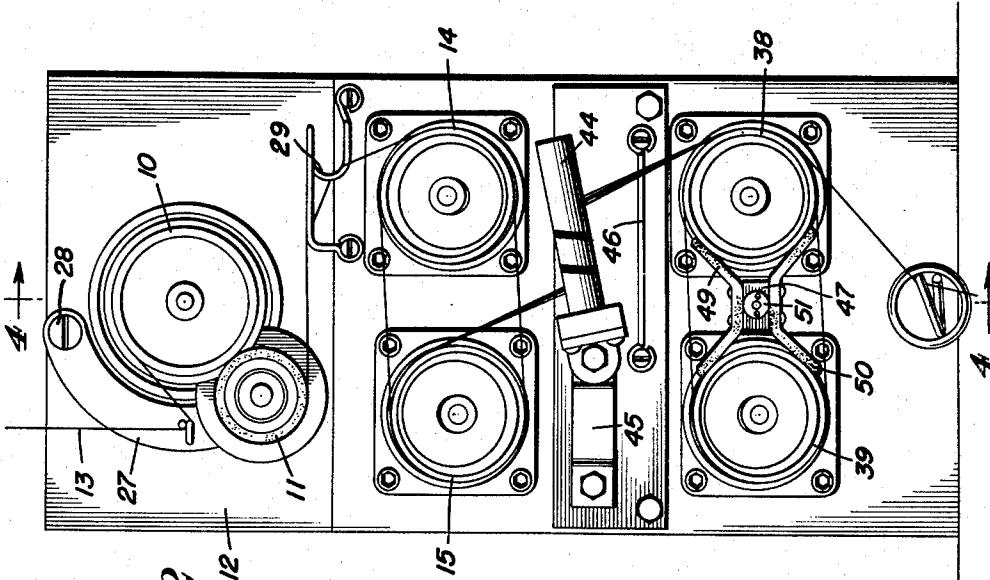


Fig. 2

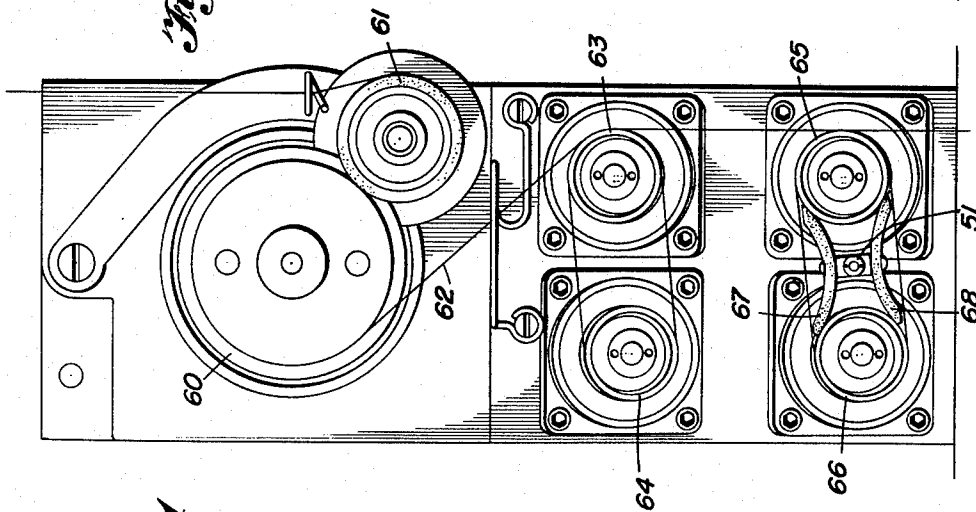


Fig. 1

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Fig. 3

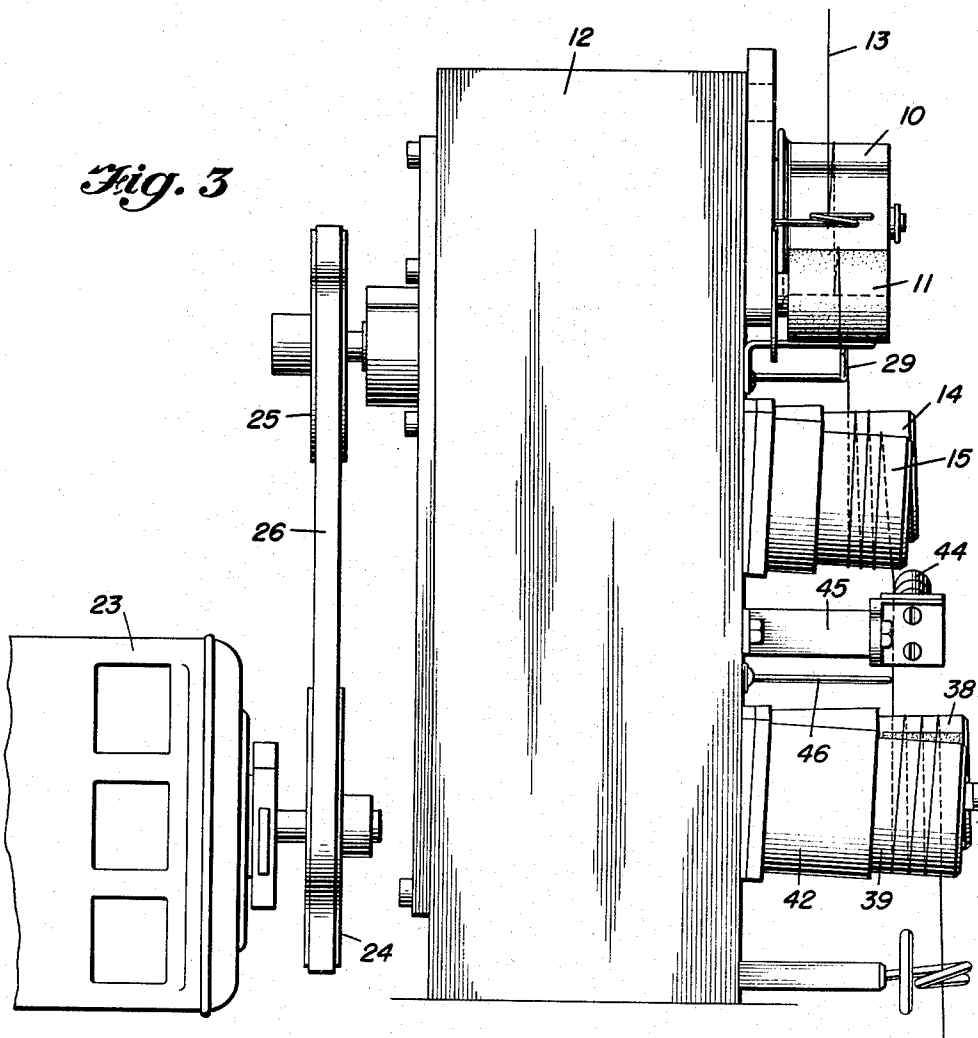
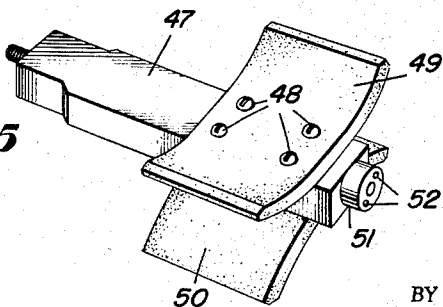


Fig. 5



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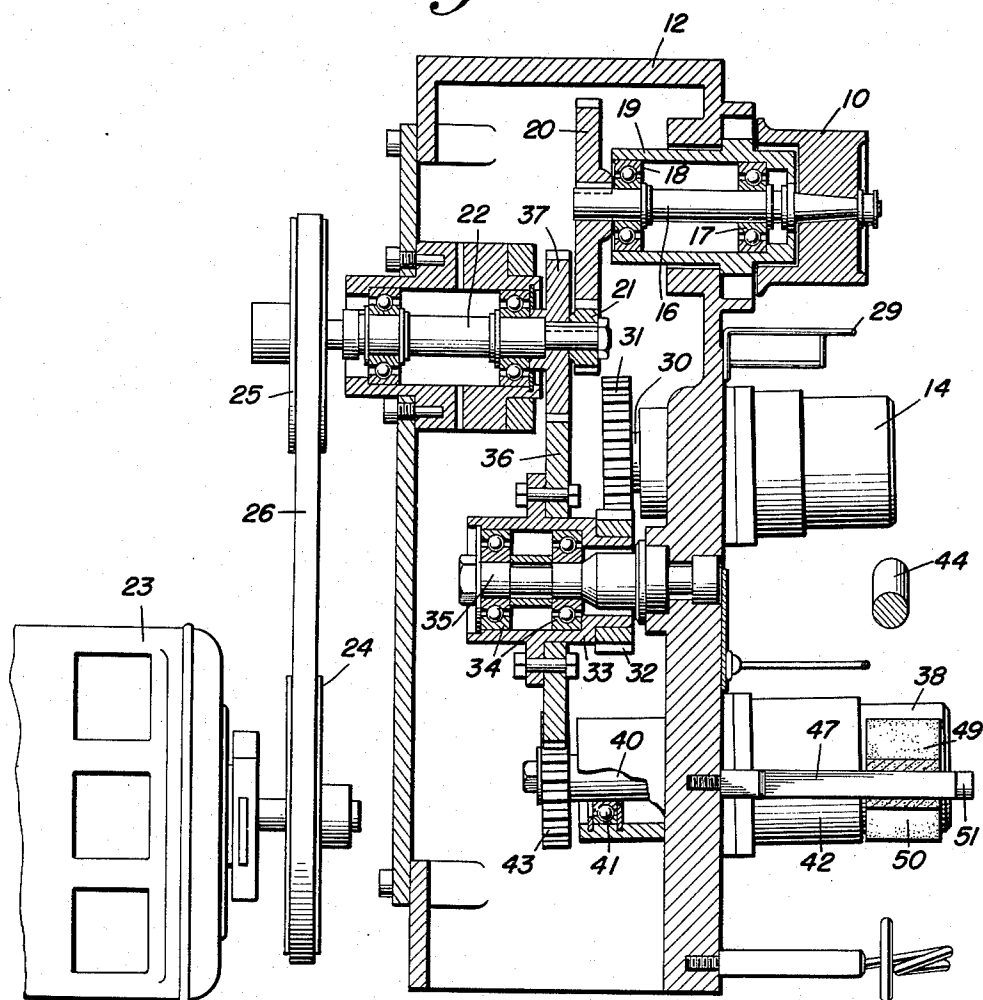
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Fig. 4



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YARN STRETCHING DEVICE

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This invention relates to a device for stretching synthetic yarn of the nylon type and more particularly to improved means for preventing the breaking of individual yarn filaments during the operation of such device.

Basically, the present invention constitutes an improvement over the device shown in the patent to Carter, No. 2,735,160 and reference may be had to said patent for certain details of construction which, while contributing to the efficient overall operation of the device, do not constitute per se an essential part of the present invention.

Polyamides, polyesters, etc. require a stretching operation after they have been spun in the form of yarns or threads in order to orient the crystalline regions thereof and thereby increase their tensile strength. These synthetic fibers have also the characteristic of holding an electrical charge and for that reason as soon as the filaments are formed they are treated with an anti-static solution, for otherwise rather large charges of static electricity would be built up on the yarn as it passed through the various subsequent operations. During the stretching of nylon-6, particularly with the heavier denier yarns which are customarily stretched around a hot pin, the nylon yarn becomes heated and this may cause some of its residual monomer, caprolactam, to sublime in the form of a sticky fog. In addition to the monomer, some of the anti-static finish is liberated during the stretching and this also enters into the sticky fog.

The present invention contemplates stretching the thermoplastic yarn between two sets of rollers, or spindles, the yarn being wound around both sets and the second set being driven at a greater peripheral speed than the first. In certain instances, particularly with the higher denier yarn such as used in making tire fabric, the yarn is passed around a so-called stretch pin located between the two sets of rollers to increase the stretching effect, since the yarn becomes more plastic due to the frictional heat produced during the passage of the yarn around the pin, the pin being non-rotatably mounted. While an unheated pin will become hot after a period of time due to the friction of the yarn passing therearound, such pin may be heated by other means, e.g. electrically.

The sticky fog referred to above has a tendency to settle upon the lower set of stretch rollers and impart an unevenly sticky surface to the normally and desirably smooth, polished rollers. Prior to the present invention, these sticky surfaces tended to snag the very fine individual nylon filaments with the result that some of the filaments were broken and the broken ones then became tightly wound around one of the rollers thereby providing a rough surface for the following yarn to pass over. The roughened surface caused by this wrapping of broken filaments around the rollers resulted in still further broken filaments until finally the machine would have to be stopped to permit the broken filaments to be removed from the stretch rollers.

It is the primary object of this invention to provide a nylon yarn stretching device of the type mentioned above having means for maintaining the stretch rolls

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clean and free from the accumulation of foreign matter whereby the breakage of individual yarn filaments during the stretching operation is greatly reduced.

Other and further objects, features and advantages of the invention will become apparent as the description of certain preferred embodiments thereof proceeds.

Referring now to the drawings:

Figure 1 is a front elevational view of a yarn stretching device constructed in accordance with the present invention,

Figure 2 is a front elevational view of a modified form of the device,

Figure 3 is a side elevational view of the yarn stretching device of Figure 2,

Figure 4 is a sectional view taken along the line 4—4 of Figure 2, and

Figure 5 is a perspective view of a wiper forming one of the elements of the invention.

Referring first to that form of the device shown in Figs. 2, 3 and 4, a pair of yarn feeding rollers 10 and 11 are mounted on a framework 12 for feeding yarn 13 from a suitable supply source to a first pair of stretch rollers 14 and 15. The roller 10 is the driving roller and as shown in Fig. 4 said roller is secured to one end of a shaft 16 rotatably mounted by means of bearings 17 and 18 within a sleeve 19 secured to and extending through the framework 12. A driving gear 20 is secured to the end of shaft 16 inside the framework, said gear being meshed with a pinion 21 keyed to a shaft 22 driven from a motor 23 through pulleys 24 and 25 and a drive belt 26.

The feed roller 11 is freely rotatably mounted upon a stub shaft carried by the lower end of an arm 27 pivotally mounted at 28 upon the framework 12. The arm 27 is biased by gravity to a position to engage the roller 11 with the surface of feed roller 10. The roller 11 is provided with a surface covering of cork or the like whereby said roller is driven by the roller 10 and together with the roller 10 serves to feed the yarn to the stretch roller 14, said yarn being passed over a suitable guide 29 whereby it is led to a position near the rearward end of said stretch roller, as best seen in Fig. 3.

The stretch roller 14 is secured to a shaft 30 rotatably mounted in the framework 12 and inside said framework a gear 31 is suitably secured to said shaft for driving it and the roller. The gear 31 is meshed with a drive pinion 32 secured to a sleeve 33 which in turn is rotatably mounted by means of bearings 34 upon a stub shaft 35 extending inwardly from the front face of the framework. A gear element 36 is secured to the sleeve 33 and is meshed with a driving pinion 37 keyed to the shaft 22 adjacent the pinion 21. The stretch roller 15 is mounted and driven similarly to the roller 14 but for simplicity of illustration such drive has not been shown. Suffice it to say that the rollers 14 and 15 are driven at the same speed by the pinion 32 so that they will act as a unit to serve as one of the points for applying tension for stretching the yarn.

Mounted upon the framework 12 below the stretch rollers 14 and 15 is a second pair of stretch rollers 38 and 39. As indicated in Fig. 4, the roller 38 is secured to a shaft 40 which is rotatably mounted by means of bearings 41, only one set of which is shown, within a sleeve 42 secured in the framework 12. The sleeve 42 is larger on the outside of the framework than on the inside thereof and serves to protect the bearings 41 from dust and from the previously referred to sticky fog given off by the nylon yarn during the stretching thereof. The shaft 40 is longer than the shaft 30 which carries the roller 14 and the similar shaft carrying roller 15 so that the roller 38 is offset forwardly of the rollers 14 and 15 with the rearward end of roller 38 substantially vertically aligned with the forward ends of rollers 14 and 15. A gear 43

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is secured to the inner end of shaft 40 and said gear is drivingly engaged with the previously referred to gear element 36 whereby roller 38 is driven at a higher peripheral speed than rollers 14 and 15 but at a fixed ratio with respect thereto. The roller 39 is mounted and driven similarly to roller 38, the roller 39 being driven by a gear of the same size as gear 43 which like gear 43, is drivingly engaged with gear element 36.

As best seen in Fig. 3, the rollers 14 and 38 are inclined upwardly at a small angle from a horizontal plane and the rollers 15 and 39 are inclined downwardly. By this arrangement the rollers 14 and 15 act as spreaders for each other so that yarn wrapped in a helical manner around the two as shown in Fig. 3 will maintain this helical arrangement during operation of the device. The rollers 38 and 39 operate similarly to maintain the helical arrangement of the yarn wrapped around them. The actual amount of inclination of the rollers is quite small and does not interfere with the proper operation of their driving gears.

By having the running strand of yarn wrapped a plurality of times around the two pairs of stretch rollers 14, 15 and 38, 39, these two pairs of rollers act as points for application of tension to the strand and, since the lower pair of rollers 38 and 39 is driven at a greater peripheral speed than the upper pair, the yarn is stretched during its passage between the two pairs of rollers.

As mentioned in the introductory portion of this specification, with higher denier yarns such as used in making tire fabric, it is desirable to heat the yarn as it passes between the two sets of stretch rollers and for this purpose, in that form of the invention shown in Figs. 2, 3 and 4, a pin 44 is non-rotatably mounted between the two sets of rollers and the yarn is passed a plurality of times around the pin. The pin 44 is preferably made of agate and is necessarily made of some very hard material with a highly polished surface so that the yarn may pass smoothly around it without snagging. The yarn is passed through the stretching device at a very high speed and due to the frictional engagement of the yarn with pin 44 said yarn becomes heated and therefore more plastic and more readily stretchable. After a period of operation the pin 44 also gets very hot and thus serves to heat the yarn still further. If desired, the pin may be preheated by suitable electrical or other means but such preheating is not absolutely necessary for satisfactory operation.

The pin 44 is secured at one end to a bracket 45 which in turn is mounted upon the front face of the framework 12. As best seen in Fig. 3, the bracket 45 positions the pin 44 so that its periphery is tangentially aligned with the forward end of roller 15 whereby the yarn passes directly from roller 15 to the pin without the necessity of any guiding means. Since, as previously mentioned, the rearward ends of rollers 38 and 39 are vertically aligned with the forward ends of rollers 14 and 15, the yarn is led away from the pin 44 at a point substantially lengthwise of the pin with respect to the point at which the yarn originally contacts the pin and it will then be properly positioned for engagement with the rearward end of roller 38. If desired, a guide bar 46 may be provided between the pin 44 and roller 38 to assure proper positioning of the yarn upon the roller.

It has been previously mentioned that during the stretching of certain thermoplastic synthetic fibers, particularly nylon-6, the heat, either generated by the stretching or supplied artificially, causes some of the residual monomer to sublime and causes liberation of some of the anti-static finish. The monomer and the finish material combine physically to form a heavy, sticky fog which, with an arrangement such as that described above, settled upon the lower stretch rollers 38 and 39. If this sticky fog is allowed to remain on the stretch rollers and accumulate to any extent, it will cause breakage of some of the extremely fine filaments which go to make up the

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yarn or cord. The broken filaments become tightly wound around the individual rollers 38 and 39 and produce an uneven surface on the rollers which causes further broken filaments, until shortly the machine must be shut down and the rollers cleaned. Various expedients, such as the use of suction, have been resorted to in the past to get rid of this sticky fog and while the prior art devices have been more or less successful, they have been expensive to install and maintain. The present invention provides an extremely simple and inexpensive, although highly effective, arrangement for keeping the rollers 38 and 39 clean and free from broken filaments, as will now be explained.

Detachably secured to the front face of the framework 12 between the rollers 38 and 39 is a member 47 toward the outwardly projecting free end of which is secured, as by means of screws 48 or the like, a pair of wiper elements 49 and 50. The ends of the wiper elements are cut at angles corresponding to the angular arrangements of rollers 38 and 39 so that the ends of said wiper elements will bear against the surfaces of said rollers along a line parallel to the axes of said rollers. It is essential that the wiper elements 49 and 50 be made of an absorbent material and a preferred material is felt because of its soft, flexible and absorbent nature. If the wiper elements are made of a hard material such as metal or plastic, the matter scraped from the rollers will drop onto the yarn during its passage between the lower sides of the rollers and either cling to the yarn or become repositioned upon the rollers. When the elements 49 and 50 are made of felt or other absorbent material they do not scrape the rollers but wipe them and the hereinbefore referred to sticky fog is absorbed by the wipers. The felt is also effective to pick up any broken filaments and prevent their winding around the rollers.

To facilitate easy changing of the wipers when they become soiled, the member 47 is provided with a longitudinally extending bore through which is passed, as best shown in Fig. 5, a rod having threads on one end for screwing into a threaded hole provided therefor in the front face of the framework 12 and having a headed portion 51 provided with openings 52 for reception of a tool. By the use of a suitable tool which fits the openings 52 the wiper elements 49 and 50 together with the carrying member 47 may be readily attached and detached.

The yarn stretching device shown in Fig. 1 is generally similar to that above described but is more adapted for the stretching of low denier yarns where a stretch pin such as the pin 44 is not required. Thus the device of Fig. 1 comprises a driving feed roller 60 and a frictionally driven feed roller 61 around and between which rollers the yarn 62 is fed to a first pair of stretch rollers 63 and 64. In this embodiment of the invention the yarn after passing several times around the two rollers 63 and 64 is passed from the right hand roller 63 directly to the right hand roller of a second pair of stretch rollers 65 and 66, the lower rollers being offset forwardly of the upper rollers in the same manner as explained with respect to the device of Fig. 2.

The driving means for the rollers of the device of Fig. 1 is the same as that previously explained in connection with the device of Fig. 2 except that the gear ratios will be different. The lower stretch rollers 65 and 66 are of course driven at a greater peripheral speed than the upper rollers 63 and 64 so that the yarn is stretched during its passage between the two sets of rollers.

While the presence of the pin 44 in that embodiment of the invention shown in Fig. 2 greatly increases the fouling of the lower stretch rollers as previously mentioned, nevertheless the problem does exist to some extent even when a stretch pin is not employed. Therefore in that form of the invention shown in Fig. 1 a pair of absorbent wipers 67 and 68 of felt or the like is mounted

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between the lower stretch rollers 65 and 66 for the purpose of keeping said rollers clean. The wipers 67 and 68, except for dimensional changes, are constructed and mounted in the identical manner as the wipers 49 and 50 and it is not necessary to repeat the description.

Having thus described two embodiments of the invention, what is claimed is:

1. In a device for stretching synthetic thermoplastic yarn containing sticky material comprising a first pair of driven stretch rollers angularly inclined with respect to each other whereby yarn wound around the rollers is advanced from the rear to the front thereof during their rotation, means for feeding yarn onto the rear of said stretch rollers, a second pair of driven stretch rollers angularly inclined with respect to each other, said second pair of stretch rollers being located below the first pair of stretch rollers and offset to the front thereof whereby yarn discharged from the front of the first pair of stretch rollers is advanced in position to be fed around the rear of said second pair of stretch rollers to be subsequently discharged from the front thereof, said second pair of stretch rollers being driven at a greater peripheral speed than said first pair so as to cause the yarn to be stretched during its passage between the two pairs of stretch rollers, a wiper for said second pair of stretch rollers comprising a supporting member and a member consisting of soft, flexible, absorbent material secured intermediate its ends to said supporting member and bearing against the surfaces of both of said second pair of stretch rollers whereby said absorbent member absorbs the sticky material liberated from the yarn and maintains the surfaces of said stretch rollers clean to thereby prevent the breakage of individual yarn filaments due to the accumulation of sticky material on said rollers.

2. The device of claim 1 wherein the soft, flexible, absorbent member is felt.

3. The device of claim 1 wherein the ends of the soft, flexible, absorbent member are angularly arranged to coincide with the angular arrangement of said second pair of stretch rollers.

4. In a device for stretching synthetic thermoplastic yarn containing a sticky material comprising a first pair

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of driven stretch rollers angularly inclined with respect to each other whereby yarn wound around the rollers is advanced from the rear to the front thereof during their rotation, means for feeding yarn onto the rear of said stretch rollers, a second pair of driven stretch rollers angularly inclined with respect to each other, said second pair of stretch rollers being located below the first pair of stretch rollers and offset to the front thereof whereby yarn discharged from the front of the first pair of stretch rollers is advanced in position to be fed around the rear of said second pair of stretch rollers to be subsequently discharged from the front thereof, said second pair of stretch rollers being driven at a greater peripheral speed than said first pair so as to cause the yarn to be stretched during its passage between the two pairs of stretch rollers, a wiper for said second pair of stretch rollers comprising a supporting member positioned between said second pair of stretch rollers, and a pair of absorbent members secured intermediate their ends to said supporting member, each of said absorbent members bearing against the surfaces of both of said second pair of stretch rollers whereby said absorbent members absorb the sticky material liberated from the yarn and maintain the surfaces of said stretch rollers clean to thereby prevent the breakage of individual yarn filaments due to the accumulation of sticky material on said rollers.

5. The device of claim 4 wherein said absorbent members are felt.

6. The device of claim 4 wherein the ends of the absorbent members are angularly arranged to coincide with the angular arrangement of said second pair of stretch rollers.

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