Dec. 12, 1944. A. F. F. MOTHWURF 2,365,096

RAYON SPINNING AND DRYING CAGE

Filed July 11, 1940 2 Sheets-Sheet 1

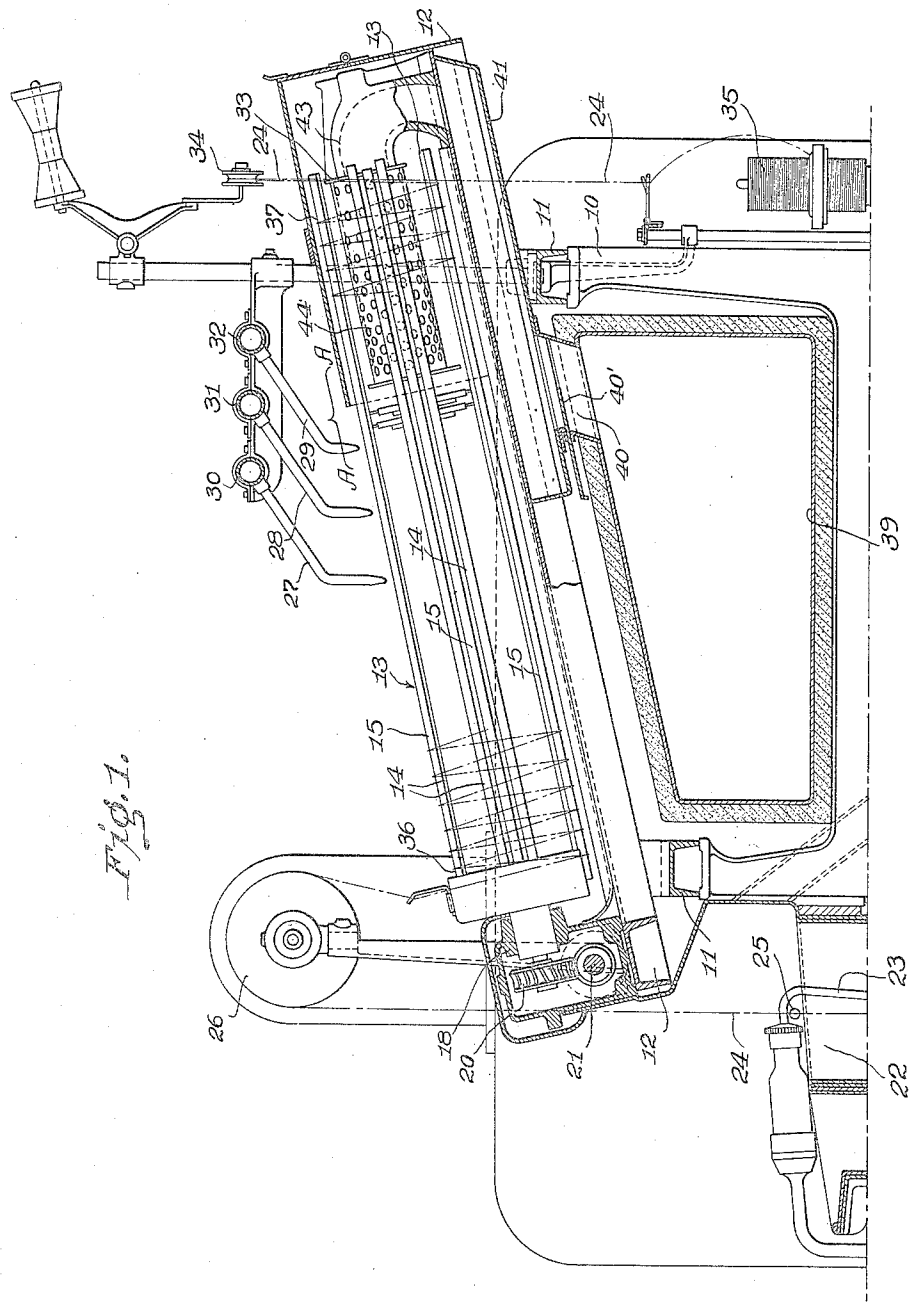


Fig. 1.

INVENTOR

Arthur F. F. Mothwurf

BY John P. Tarbox

ATTORNEY

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Fig. 2.

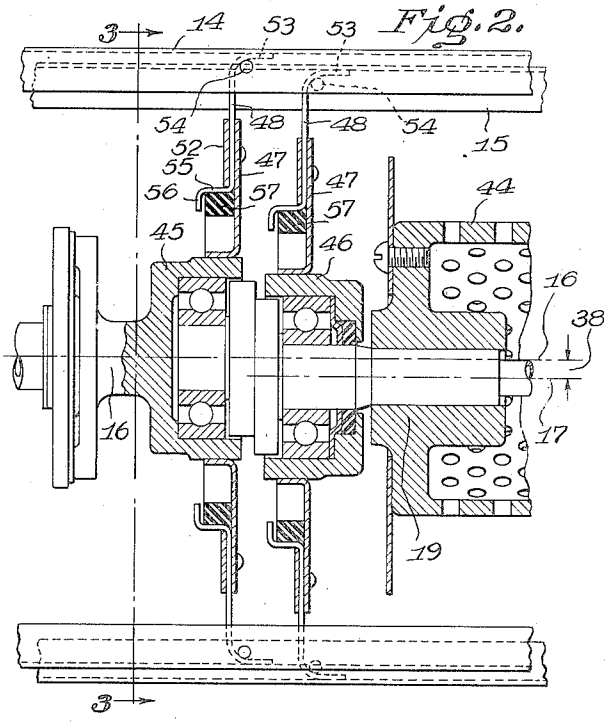


Fig. 3.

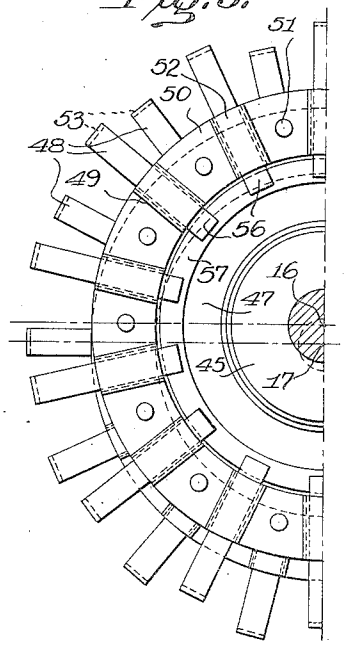


Fig. 4.

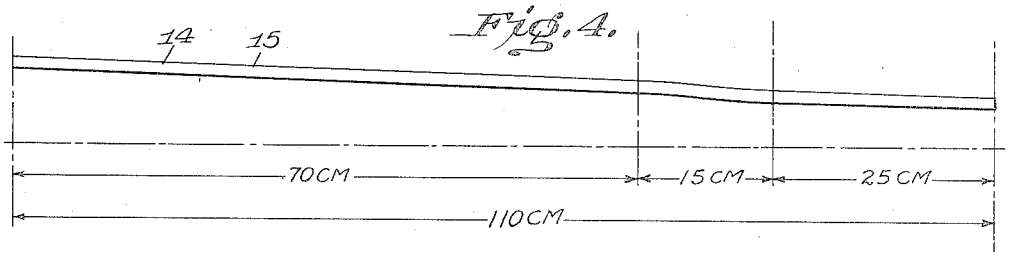
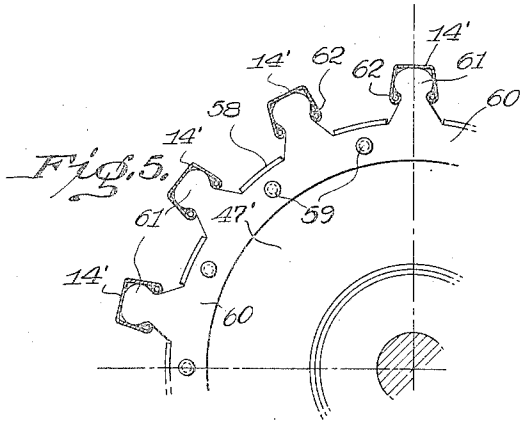


Fig. 5.



INVENTOR
Arthur F. F. Mothwurf
BY John P. Taboz
ATTORNEY

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RAYON SPINNING AND DRYING CAGE

Arthur F. F. Mothwurf, Philadelphia, Pa., assignor, by mesne assignments, to Industrial Rayon Corporation, a corporation of Delaware

Application July 11, 1940, Serial No. 344,947

6 Claims. (Cl. 18—8)

The invention relates to an apparatus for spinning rayon.

One object of my invention is to improve the uniformity of the rayon yarn with regard to elasticity, tenacity and dye absorption as produced upon unitary spinning thread storage devices as distinguished from production upon a multiple number of such devices. Albeit, my invention may be found to have some application to certain groupings of such multiple storage devices.

Another object of my invention is to improve the correlation between the drying and resultant shrinkage and the tension imposed upon the yarn by the thread storage device, whereby the tension may be maintained substantially uniform along the length and below such tension as might prove injurious to the resultant product.

My invention is based on the discovery that uniformity of yarn produced on a unitary or multiple yarn storage device depends on eliminating during the process any possible strain on the yarn which results from its shrinkage during the various phases of the process.

There are various correlated means by which my purpose is achieved.

I carry out my invention by utilizing a unitary thread storage device of the cage type in which the thread is carried upon substantially cylindrical interleaved cages comprised of two or more sets of bars which alternate with each other in their engagement with the thread and advance it spirally upon the drum from one end to the other. The drum is inclined downwardly toward the leading-in end. The regenerative treatments are applied to the thread by dripping upon the drum and the thread which it carries, the regenerative treatments at various points along the length of the drum. I shape the bars which comprise this cage drum to afford a cage, the circumference of which progressively decreases at the same rate of decrease of length which applies to the yarn being spirally advanced upon it. For instance for a drum of approximately 110 cm. in length I shape the bars to afford a decrease in circumference in the first 70 cm. of from 628 mm. at the leading-in end to approximately 596 mm. at a distance of 70 cm. therebeyond toward the delivery end. and from this point to the delivery end first abruptly increase the rate for about an additional 15 cm. and then continue at the same rate as applies to the initial 70 cm. of length to the delivery or upper end, effecting a total decrease in circumference of from 596 mm. at the 70 cm. point to 575 mm. at the delivery end, a distance of 40 cm.

This example applies to a viscose spun yarn of substantially 150 denier. It is subject to variation with denier and is also subject to variation when applied to cupro-ammonium yarn. The nature of the regenerative treatment may also afford some variation.

In principle, however, my apparatus is the same for all denier of yarn and for all kinds of rayon.

I have discovered further that hot air circulation in controlled volume per minute and of controlled humidity affords the best medium for the regulating of the tendency for greatly accelerated reduction in yarn length upon the initiation of the drying.

In carrying out the apparatus phase of the invention therefore I introduce hot air through a perforated head, the perforations of which are adjusted in area to afford the proper volume of air passing each zone of the yarn being dried upon the storage device.

Yet further, my apparatus provides for the self regulation of the tension of the yarn upon the storage device in accord with its changes in length in order that minor discrepancies between the fixed shape of the bars, the resulting circumferences, and the lengths of the thread turns as determined by its constitution, treatment, etc., will be automatically taken care of.

This phase of my invention I carry out by developing a flexible circumference for the cage. In the preferred embodiment of my invention I circumferentially elastically mount the bars in or near the zone of greatest rate of decrease of circumference, i. e. in the zone of their mounting adjacent the drying zone.

In the accompanying drawings I show two embodiments of my invention in which are illustrated each of two different means of elastic mounting.

Referring now to the drawings,

Fig. 1 is a transverse cross section of a multiple cage spinning machine taken upon the axis of one of the spinning cages.

Figure 2 is an enlarged axial cross section of the circumferentially elastic mounting in the zone adjoining the drying zone of the cage approximately in the region A—A of Fig. 1.

Figure 3 is an end elevation of this elastic mounting taken in transverse cross section of the cage approximately on line 3—3 of Fig. 2.

Figure 4 is a diagram showing in an enlarged way an example of the rates of decrease of circumference applying to the cage, the illustration being that of the longitudinal axial change in inclination toward the axis of the cage of a single

bar. The rates of decrease are exaggerated for clarity.

Figure 5 is a broken segment section similar to that of Fig. 3 for the modification of the circumferentially elastic mounting of the bars.

In Fig. 1, 10 is the main frame of the spinning machine comprised of castings and channel cross sectioned structural iron mounted transversely upon longitudinally extending channel shape stringers 11 which are at different heights, and channel cross sectioned unitary cage bearing transverse beams 12, the channels of which like those of the stringers 11 are down turned. Each one of the down turned channel beams 12 (of which only one is shown though there may be a large number upon a single frame 10, 11, as is well known in the spinning machine art), carries a unitary thread storage device 13 in the form of a cage of transversely extending bars 14 and 15 mounted upon transversely extending axes 16 and 17 (see Figs. 2 and 3). The axes 16 and 17 are in the form of shafts and stub shafts, each supported from bearing brackets 18 and 19 from opposite ends of the transverse beams 12. All of the shafts in the machine are driven by worm gears 20 commonly from a through running worm shaft 21.

The yarn is spun in a bath 22 from a spinneret (not shown), but which is fed at the bottom of the bath from a supply pipe 23, is advanced upwardly from the bath as indicated at 24 and through suitable tensioning guides indicated diagrammatically at 25 over the Godet wheel 26 which may be supported in any suitable manner from the frame of the machine, and down upon the unitary storage device cage 13 at substantially the same circumferential speed as the cage revolves. Thereby all the stretch it is desired to give the yarn is imposed in that section between the guide 25 and the wheel 26. This tension is regulated by the regulation of the number and nature of the guides 25.

Reaching the drum the yarn is subjected to a counterflow treatment from a rinse drip 27, a desulphurizing drip 28, and a bleaching drip 29, supplied respectively from the three treatment mains 30, 31 and 32.

The cage advances the yarn spirally and over and beyond the drying device 33 located within its upper end. The guide thread 24 leaves the cage to pass over a guide roll at 34 and thence downwardly to the spool 35 upon which it is wound with a balloon effected twist.

The spiral feed of the thread from the leading-in end 36 to the delivery end 37 of the thread storage device is effected by mounting bars 14 and 15 respectively alternately upon the axes 16 and 17, by spacing these axes apart slightly (the spacing being indicated at 38 in Figs. 2 and 3) to lie in substantially parallel planes and in these parallel planes displacing the axes slightly at an angle to each other. This latter is not illustrated fully because it is well known in the art. Thereby the upper and lower (or right and left) half circumference of the yarn turns are borne respectively upon the sets of bars 14 and 15, and thereby (through the relative angularity of the axes) the turns are afforded the spiral form and lead which effects the progression.

Each individual bar 14 or 15 as the case may be is inclined toward the axis of its group as outlined in Fig. 4 illustrating a bar for a 110 cm. length of storage device. The bar from the leading-in end 36 to a point approximately 70 cm. therefrom approaches the axis at a substantially uniform rate. For the next 15 cm. the rate is an accelerated one, first increasing markedly then decreasing and once more assuming the rate applying to the initial 70 cm. of length. For the remaining 25 cm. of length, the inclination is the same as on the initial 70 cm. of length as may be noted from the parallel lines. For the spinning of viscose yarn of from 100 to 300 denier, I have found such proportioning of the inclination to be desirable. The circumferential figures have been given previously.

Coaction of the drying device in conformance to the determinate circumferential variations of the turns of yarn is afforded through the supply of compressed air from a longitudinally through running main 39 within the main frame of the machine by a branch duct 40 having a slide regulating valve 40' which feeds the conduit comprised by the channel 12 and closing in header 41, to carry air through an aperture 42 in the top of the channel 12 to the hollow of supporting head 43 from whence it is distributed to the interior of the cage 13 through a perforated head 44. The perforations in this head distribute the air in conformance with the tendency of the yarn itself for greatest shrinkage in length in the 15 cm. zone illustrated in Fig. 4. The temperature, quantity and humidity of the air are adjusted to the values found most suitable. I have found that air at 85° C. has an ability to absorb as much as 30 grams of water per cubic meter. The quantity of air may be adjusted to the quantity of moisture to be removed on this basis to obtain satisfactory results.

Finally I effect the automatic flexibility of the circumference by the construction shown in Figs. 2, 3 and 5. First referring to Figs. 2 and 3 it will be seen that the respective bearings 45 and 46 which support the respective sets of bars 14 and 15 adjacent the perforated drying head 44, effect this support through pressed metal discs 47 and connected individually radially movable fingers 48. These fingers have relative radial movements as respect the disc 47 by reason of their being borne slidably in radial bearings 49 formed between the faces of the disc 47 and the faces of retaining rings 50, which are secured thereto (preferably removably) at the points 51 by any suitable means. The rings 50 have their bodies offset in the regions 52 by the thickness of the fingers 48 in order to provide ways in which the fingers 48 may move radially.

The fingers 48 at their upper ends are bent over as at 53 to contact with the undersides of the channel section bars 14 and 15, and the bars are retained on these bent over ends 53 by means of transverse pins 54.

At their inner ends the fingers 48 are bent at right angles as at 55 and then again radially inwardly as at 56 to bear by their portions 55 upon the outer periphery of rings 57 of elastic material such as rubber or the like, and by their portions 56 to confine these rings axially against the faces of the plates 47.

The bars 14 and 15 are assembled in relation to these bars in such a manner as initially to place the elastic 57 under compression of a moderate degree commensurate with that degree of aggregate tension of the turns of yarn upon the cage 14 which suffices to retain the yarn in place during the drying operation upon the cage.

In the modified form of Fig. 5, the disc 47 is merely provided with a rubber or other yielding spider ring 60, the radial rubber knob like portions 61 being adapted to be removably clipped

between the beaded channel flanges 62 of the bars 14'. The disc 47' may have piloting flanges 58 between radial knobs and may be secured to the ring by rivets 59. Such an arrangement permits such yielding as may be essential to maintain uniform tension of the thread upon the drum.

It is a feature of my invention that this tension be adjusted to that minimum requisite for this purpose and that there be no more resisting compression of the elastic rings 57 (or 60) which afford circumferential elasticity than is necessary for this purpose. Under these conditions the unitary thread storage device of my invention has that kind of circumferential elasticity which will afford moderate decrease of give and take with the yarn and prevent those undue stretchings of the yarn which decrease its elasticity as a finished product. Such preliminary stretch as I effect between guides 25 and wheels 26 will give the yarn increased tensile strength and will effect that specific elasticity of the final product which I desire. I may regulate this between the Godet wheel 26 and the thread guides 25 before the thread reaches the storage device, but during treatment upon the storage device I do not alter this relative adjustment of tensile strength and elasticity of the resulting product. Rather my invention is directed to maintaining it through the step of maintaining such exact a conformance of changes in storage device circumference to the changes in length of the yarn as possible, and so far as consistent with the retention of the yarn upon the drum by the combined forces of its adhesion under the influence of the treating solutions and such modest tension as may be required in supplement thereto.

What I claim is:

1. A thread storage drum comprising at least two interleaved cages having longitudinal substantially rigid bars, each of said cages being mounted on a pair of spaced supporting means, the arrangement of said cages and their mounting on the supporting means being such as to advance thread in a spiral path thereover, one of said pair of spaced supporting means including resilient means for supporting the bars of one of said cages, and guiding means for positively confining such resiliently supported bars to radial movement with respect to said suporting means.

2. A thread storage drum comprising at least two interleaved cages having longitudinal substantially rigid bars, each of said cages being mounted on a pair of spaced supporting means, the arrangement of said cages and their mounting on the supporting members being such as to advance thread in a spiral path thereover and the diameter of said drum being such as to compensate for shrinkage of the thread as it passes thereover, one of said pair of spaced supporting means including resilient means for supporting the bars of one of said cages whereby the circumference of the drum may yieldingly vary.

3. A thread storage drum comprising at least two interleaved cages having longitudinal substantially rigid bars, each of said cages being mounted on a pair of spaced supporting means, the arrangement of said cages and their mounting on the supporting means being such as to advance thread in a spiral path thereover, one of said pair of spaced supporting means being adapted to hold a resilient ring at a plurality of circumferentially spaced points, the bars of one of said cages being circumferentially arranged around said resilient ring, and means included in said one of said pair of spaced supporting means for radially and individually supporting said bars upon said resilient ring.

4. A thread storage drum comprising at least two interleaved cages having longitudinal substantially rigid bars, each of said cages being mounted on a pair of spaced supporting means, the arrangement of said cages and their mounting on the supporting means being such as to advance thread in a spiral path thereover, a resilient ring mounted on one of said pair of spaced supporting means, said ring having radially extending members, the bars of one of said cages being circumferentially arranged around said resilient ring and supported by said radially extending members, and means for holding said bars upon said radially extending members.

5. A unitary thread storage drum comprising at least two interleaved cages having longitudinal substantially rigid bars, each of said cages being mounted on a pair of spaced supporting means, the arrangement of said cages and their mounting on the supporting means being such as to advance thread in a spiral path thereover, an initial portion of said drum being provided with means and being of sufficient length for subjecting a freshly precipitated thread to the required fluid treatments, means for drying the thread as it passes over a portion of the drum, said drum being constructed and arranged so as to have a varying diameter in the direction of travel of the thread in accordance with the shrinkage of the thread passing thereover, one of said pair of spaced supporting means including resilient means for supporting the bars of one of said cages, and guiding means for positively confining such resiliently supported bars to radial movement with respect to said supporting means.

6. A unitary thread storage drum comprising at least two interleaved cages having longitudinal substantially rigid bars, each of said cages being mounted on a pair of spaced supporting means, the arrangement of said cages and their mounting on the supporting means being such as to advance thread in a spiral path thereover, an initial portion of said drum being provided with means and being of sufficient length for subjecting a freshly precipitated thread to the required fluid treatments, means for drying the thread as it passes over a portion of the drum, said drum being constructed and arranged so as to have a varying diameter in the direction of travel of the thread in accordance with the shrinkage of the thread passing thereover, one of said pair of spaced supporting means including resilient means for supporting the bars of one of said cages along the discharge end of said drum.

ARTHUR F. F. MOTHWURF.