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# UNITED STATES PATENT OFFICE 

2,132,753<br>FARN AND CORD STRETCHING APPARATUS

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3 Claims. (C1. 28-57)

This invention relates to the manufacture of yarns, plied yarn or cord, and particularly to the manufacture of such yarn or cord as is used in tire casings, in fabric belts or tapes, in seines or cord of high strength but of limited stretch is desirable.
Ordinary plied yarn or cord will stretch substantially when in use and may cause slackness or looseness in a tire casing, net or other article which will seriously reduce its life and utility. Such stretch and looseness has been found particularly objectionable in tire casings, as lengthened cords may cause a casing to become loose on its wheel after a limited period of use.

It has been proposed to submit tire cords and other similar products to a definite stretching operation, either before or after the plied yarns are twisted together. By this stretching operation, the yarn or cord is decreased in size, weight and twist but is increased in length and strength. The stretch within breaking limits is also greatly reduced, as, for example, from $30 \%$ to $5 \%$ stretch. Subsequent stretch of the cord or fabric when in use is correspondingly reduced.

It is the object of my invention to provide improved apparatus for thus stretching yarns, plied yarns or cords to reduce their residual stretch and to increase their strength.
30 My invention further relates to arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claims.

Preferred forms of the invention are shown in 35 the drawings, in which

Fig. 1 is a partial front elevation, partly in section, of one form of my improved stretching apparatus;
Fig. 2 is a sectional side elevation, taken along
Flg. 3 is a diagrammatic sectional view, taken along the line 3 - 3 in Fig. 1;
Fig. 4 is a view similar to Fig. 2 but showing my invention as adapted to winding instead of twist45 ing;

Fig. 5 is a detall front elevation of certain traverse mechanism;
Fig. 6 is a front view of a modifled form of my invention;
Fig. 7 is a sectional end elevation, looking in the direction of the arrow 1 in Fig. 6;
FHg. 8 is a sectional end view of another modified construction;
Fig. 9 is a sectional elevation of a further modi55 fication; and

FIg. 10 is a diagrammatic side elevation, looking in the direction of the arrow 10 in Fig. 9.

Referring to Figs. 1, 2 and 3, I have shown my invention embodied in apparatus by which plied yarns $Y$ are twisted together to form a cord $C$.

Each yarn $Y$ is commonly formed of a plurality of strands which have been previously twisted together in a preliminary twisting operation. In a typlcal tire cord, five strands are twisted together to form each yarn $Y$ and three yarns $\mathbf{Y}$ are twisted together to form the cord $\mathbf{C}$. It is usual to use No. 23 strands in tire cords and such cord is commonly designated " 23 's $/ 5 / 3$." As far as my present invention is concerned, however, both the size and number of the strands and yarns may be substantially varied.
The yarns $Y$ are supplied from spools $S$ on a suitable frame or creel 10 mounted above my improved stretching apparatus. For wet twisting, the yarns $Y$ are drawn downward and under a guide-roll 11 mounted in a trough 12 which may contain water or other suitable moistening liquid. The yarns $Y$ are then passed over a guiderod 14 and are conducted to my improved stretching apparatus, indicated generally by the letter A. 25
The assembled yarns $Y$ are then drawn through a guide-wire 15 , axially aligned with a rotated spool $\mathrm{S}^{\prime}$. The yarns are then drawn downward from the guide-wire 15 through a traveler $T$ on a ring $R$ and are twisted to form a cord $C$ by 3 rotation of the spool $S^{\prime}$ during the downward travel of the yarns from the guide-wire 15 to said spool. The usual relative axial traverse between the spool $S^{\prime}$ and ring $R$ will be provided.

My improved stretching apparatus A comprises a pair of upper rolls 20 and 21 and a pair of lower rolls 22 and 23. The rolls 20 and 21 , are driven at the same speed and in the same direction, and the rolls 22 and 23 are also driven at the same speed and in the same direction, but the surface speed of the rolls 22 and 23 is somewhat greater than the surface speed of the rolls 20 and 21.

In Figs. 1 and 3, I have indicated the rolls 20 and 21 as provided with equal gears 25 engaging an intermediate gear 26. I have also shown a gear 21 rotatable with the gear 26 and engaging a gear 28 on the lower roll 22 . The rolls 22 and 23 are provided with gears 29 engaging an intermediate gear 30. I have also indicated the lower front roll 22 as being power-driven through an extension of its shaft 32 (Fig. 1) but power may be equally well applied to any other member of the gear train.

In order to prevent grooving of the rolls, trav- 65
erse rods 33 and 34 are mounted between the rolls of each pair respectively, and are provided with pins 35 between which the yarns are guided. Any suitable means may be provided for recip5 rocating the traverse bars 33 and 34 . One form of such mechanism is shown in Fig. 5, in which the bars 33 and 34 are pivotally mounted at the upper and lower ends of a bell crank lever 40 having an extensible arm 41 oscillated by an ec0 centric 42.

In the use of my improved stretching apparatus, the gears 27 and 28 will be selected to give the desired surface speed ratio between the upper rolls and the lower rolls, the lower rolls being 5 always driven at somewhat faster surface speed. The yarns Y , after passing through the liquid in the trough 12, are wound several times around the upper rolls 20 and 21, as indicated in Figs. 1 and 2, with the separate windings spaced apart
20 by the pins 35. The yarns are then brought downward from the upper roll 21 to the lower roil 22 and are passed several times around the lower rolls 22 and 23 prior to delivery through the guide-wire 15 to the spool $S^{\prime}$.
By passing the yarns several times around the two upper rolls and several times around the two lower rolls, each pair of rolls obtains a firm grip on the yarns but without the use of presser rolls or other devices tending to deform or other30 wise injure the yarns.

The relatively faster surface speed of the lower rolls produces a definite and predetermined stretch in the yarns as they pass from the roll 21 to the roll 22, and this stretch may be pre35 determined and controlled by suitable selection of the change gears 27 and 28.
The yarn is thus stretched by my improved apparatus under most advantageous conditions and with no chance of injury or deformation 0 during the stretching operation. If dry twisting is preferred, the liquid may be drawn off from the trough 12 or the yarns $Y$ may be led directly to the guide-rod 14.

In Fig. 4 I have shown my improved stretch45 ing apparatus embodied in a construction by which a cord $C^{\prime}$ is stretched after the twisting operation. The unstretched cord $C^{\prime}$ is supplied from a spool $\mathrm{S}^{2}$ and is drawn downward into the trough 12 and passed through the stretch50 ing apparatus A to the guide-wire 15, all as previously described. From this point, however, the stretched cord $C^{\prime}$ passes to a guide-wire 50 which has an axial traverse motion relative to the spool $S^{3}$ on which the stretched cord is tred but no twisting takes place after the tion of the stretching all features of construction of the stretching apparatus A are as previously described.
In Figs. 6 and 7 I have shown a modified conthe the stretching apparatus, in which the two pairs of stretching rolls are mounted in a single vertical plane, instead of being placed in upper and lower horizontal planes as previous6560 described. The upper and slower set of rolls 60 and 61 will be driven at one speed and the
lower and faster set of rolls 62 and 63 will be lower and faster set of rolls 62 and 63 will be driven at a predetermined higher surface speed. Traverse bars 33 and 34 will be provided between the two sets of rolls and will be recipro-
70 cated by suitable traverse mechanism. The yarn cated by suitable traverse mechanism. The yarn or cord Y' may be supplied from spools $\mathbf{S}^{4}$. The
method of operation and advantages of this form of my improved stretching apparatus are the same as previously described.

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vertically disposed as shown in Figs. 6 and 7, are horizontally disposed, with the left-hand pair of rolls 10 and 71 rotating at slower surface speed than the right-hand pair of rolls 12 and 13. The yarn or cord is indicated at $\mathrm{Y}^{2}$.

In Figs. 9 and $10 I$ have shown an additional modification in which the rolls of each pair of rolls 80 and 81 or 82 and 83 are horizontally disposed relative to each other but in which the two pairs of rolls or stretching units are vertically superposed. In this modification, the rolls are indicated as of short length and projecting outwardly from the ends of short driving shafts, so that the outer ends of the rolls are unconfined, and threading of the yarn or cord $\mathrm{Y}^{3}$ around the rolls is greatly facilitated. The yarn or cord may be supplied from a spool $S^{5}$.
I have also shown an optional gear drive in Figs. 9 and 10, by which the roll 80 is driven by spiral gears from a shaft 84 and the roll 82 is driven by spiral gears from a shaft 85. The shafts 84 and 85 will be rotated in desired speed relation by driving mechanism not shown. The rolls 80 and 81 are geared to rotate at the same speed and the rolls 82 and 83 are similarly geared together, all as previously described.
In the forms shown in Figs. 6 to 10 I have indicated the yarn or cord as being stretched and as being thereafter wound directly on a spool but it will be understood that in any of these forms a plurality of yarns or cords may be used and a traveler and ring may be provided for twisting the yarns or cords together before winding on the spool, all as indicated in Fig. 2.
Having thus described several additional forms of my invention, it will be evident that each form possesses the outstanding advantages previously pointed out in connection with the construction shown in Figs. 1, 2 and 3. In every case, the winding of the yarn or cord several times around a pair of rolls driven at one speed and several times around a pair of rolls driven at a definitely higher surface speed enables me to stretch the yarn or cord to a predetermined extent or ratio and without injurious pressing or gripping of the elements to be stretched.
In the claims, the term "yarn" is to be considered as covering a single yarn, a plurality of yarns, plied yarns or cord.
Having thus described my invention and the advantages thereof, I do not wish to be limited to the details herein disclosed, otherwise than as set forth in the claims, but what I claim is:-

1. Yarn stretching apparatus comprising a pair of coacting yarn-receiving rolls rotated at 5 equal surface speeds on adjacent parallel axes, a pair of coacting yarn-delivery rolls rotated at equal surface speeds on adjacent parallel axes, means to provide a predetermined increase in surface speed of said second pair over said first pair, means to supply unstretched yarn to said first pair, means to receive stretched yarn from said second pair, and means to guide said yarn in a plurality of parallel turns around said first pair of rolls and thereafter in a plurality of parallel turns around said second pair of rolls, said yarn being delivered from said first pair direct to said second pair and being stretched dur-
2. Yarn stretching apparatus comprising a pair 70 of parallel cylindrical rolls geared to rotate at equal surface speeds, a second pair of parallel cylindrical rolls geared to rotate at equal surface speeds, change gearing to drive said pairs of rolls in predetermined speed ratio, and means to gulde

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unstretched yarn around said first pair of rolls in a plurality of turns and to guide stretched yarn around said second pair in a plurality of turns, said yarn being delivered from said first 5 pair to said second pair and being stretched during such delivery.
3. Yarn stretching apparatus comprising a pair of parallel adjacent cylindrical rolls rotated at a given surface speed, a second pair of 10 adjacent parallel cylindrical rolls rotated at a higher surface speed, gearing to drive said rolls
in predetermined speed ratio, means to change said ratio, and means to guide unstretched yarn around said first pair in a plurality of separated turns and to guide stretched yarn around said second pair in a plurality of separated turns, 5 said yarn being delivered from said first pair of rolls directly to said second pair and being stretched between said pairs, and said yarn gripping said pairs of rolls by surface friction contact only.

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