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K. B. COOK ET AL

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METHOD OF MAKING TIRE CORD

Filed May 16, 1929

Fig. 2

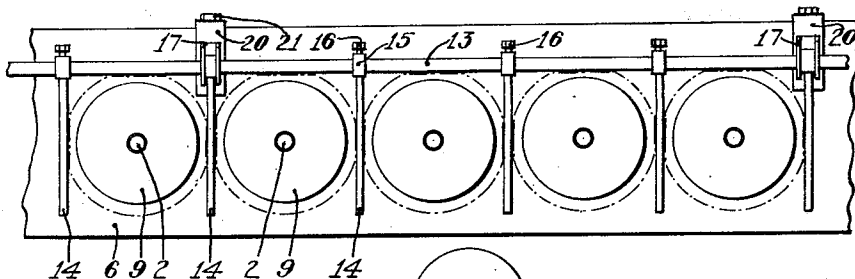
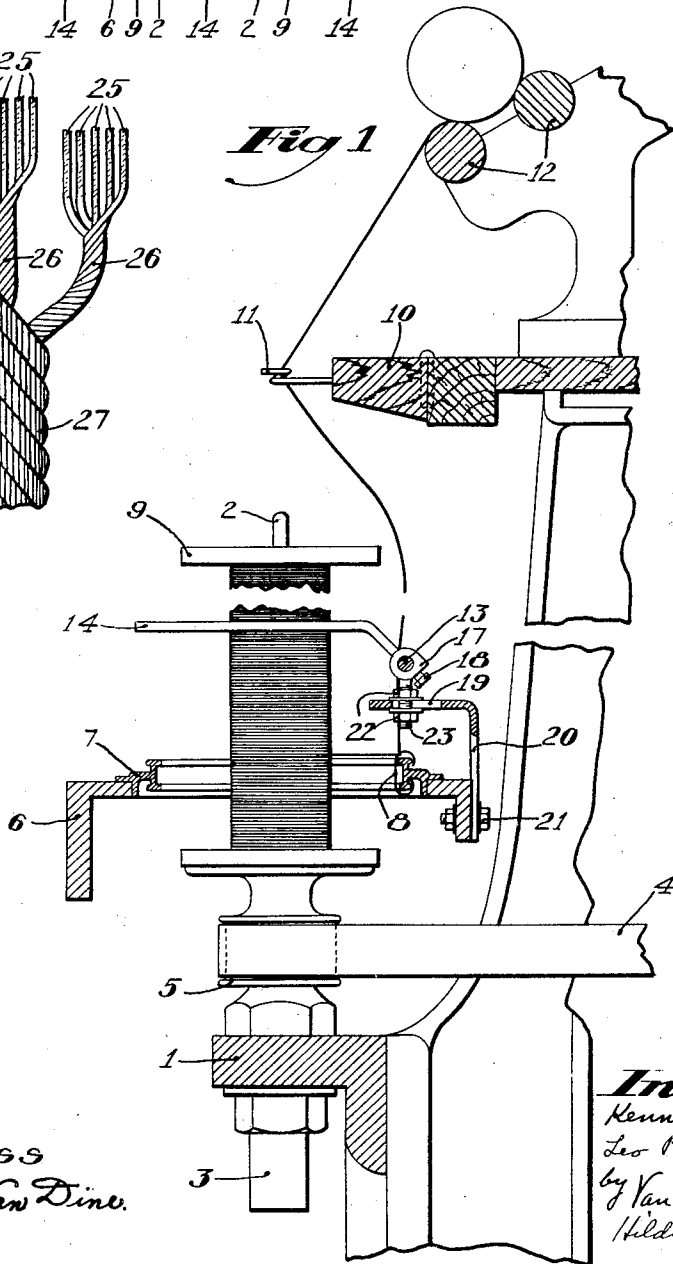
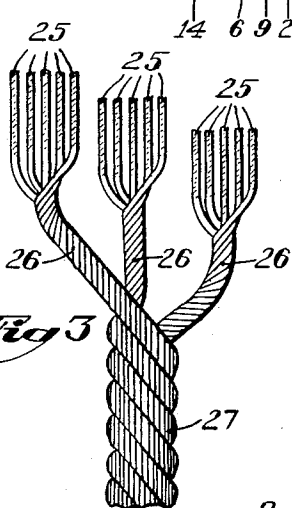


Fig 1

Fig 3



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UNITED STATES PATENT OFFICE

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METHOD OF MAKING TIRE CORD

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The present invention has relation to the manufacture of tire cord such as is employed to form the stress-resisting elements entering into the formation of a cord tire for automobiles.

It has been found to be of exceptional advantage to employ, in the making of such cord tires, cords so constructed as to be possessed of a high degree of elasticity in addition to great tensile strength. In fact, the degree of elasticity has proved to be of such importance that in certain instances tire cords have been produced in which a portion of the tensile strength has been sacrificed in order to permit an increase in the elasticity, and tires constructed from these cords have been found to have double the length of life in actual use as compared to tires made with cords of older type having the maximum tensile strength attainable in their size but possessed of no special amount of elasticity.

It is well known in the art that the tensile strength of a yarn or cord containing in its cross-section a given number of fibers of a given type is dependent on the amount of twist inserted under normal tension to cause close coherence of the fibres. The tensile strength increases as the number of turns per inch is increased, up to the point where the individual fibers begin to be strained and weakened by the twisting, and if the twisting is carried beyond this point the tensile strength is materially reduced. But the degree of elasticity increases also in proportion to the increase in the number of turns of twist per inch, and continues to do so as the twisting is continued beyond the said point of maximum tensile strength. Hence the practice of attaining increased elasticity by twisting the component parts of the cord beyond the point at which maximum tensile strength is reached has been restored to, even at the cost of reducing the strength of the cord, as illustrated and described in U. S. Letters Patent No. 1,632,201, granted to S. A. Steere, on June 14, 1927.

We have discovered that it is possible to retain the maximum tensile strength attainable in a tire cord made of the usual types of fiber and put together with the usual arrange-

ment of yarns and strands in the cable, while imparting a degree of elasticity equalling that of cords twisted to an extent impairing the tensile strength as aforesaid.

This result we attain by inserting the normal amount of twist to produce a cord of the maximum tensile strength, under special conditions of materially reduced tension. The relatively relaxed condition during the twisting and during the accompanying winding upon bobbins or the like carriers results in imparting to and preserving in the cord a degree of elasticity exceeding that attained hitherto in our experience by any tire cord of equivalent construction and of equal tensile strength.

The attempt to reduce materially the tension during the twisting and accompanying winding has given rise to practical difficulties resulting from the limitations of the twisting and winding devices best adapted and most commonly used to effect the combination of the several parts of a cord into the finished cable. These devices are the well-known ring twisting-frames. The tension in such ring frames is chiefly controlled by the weight of the traveller which courses around on the ring, and the tension on the ends being twisted is diminished substantially in proportion to the reduction in weight of the traveller. Reduction of the traveller's weight increases the size of the balloon formed between the ring and the thread guide, which if unrestrained produces too great an angular deflection of the end where it passes through said guide and prevents the twist running back as necessary to the feed-rolls; further, since the distance from center to center of adjacent spindles is limited, the ends being twisted thereon become entangled and break if their balloons are allowed to touch. The use of guards in the nature of anti-ballooners or separators of known types is not permissible to prevent such interference, in the making of tire cord in general, because of the mechanical damage inflicted on a substance so relatively heavy as a tire cord when striking at high speed, and because of the injury to the cord caused by its picking up from such guards the grease

thrown off from the ring by the traveller, along with the slubs of lint and fly accumulating on such grease; further, the resistance to the whirling of the end forming the balloon, resulting from contact with guards of known types, increases the drag on the end and hence increases the tension in a way tending to defeat the principles of the present invention.

In carrying the invention into effect, we have devised and effected the novel and improved product, means and combinations of parts shown and described in the accompanying drawings and specification, and set forth in the subjoined claim.

In the drawings Fig. 1 is a view in sectional side elevation of a portion of a ring twisting frame, showing applied thereto the balloon-regulating means employed in carrying the invention into effect; Fig. 2 is a view of a portion of a ring frame with said means applied thereto; Fig. 3 shows on a large scale the structure of the cord.

At 1 is indicated a portion of the spindle rail of a typical ring twisting frame, with spindles 2 mounted thereon by means of their bolsters 3 and revolved by bands 4 passing around adjacent pairs of pulleys 5. At 6 is the ring rail carrying the rings 7 on which the travellers 8 slide in making their circuit of the bobbins 9 carried by the spindles. The ring rail is traversed up and down by suitable means not shown, to build up the bobbin in proper manner during the winding. At 10 is the thread board, with its guide eye 11, and at 12 the feeding rolls, driven in familiar manner by means not shown.

In practising our invention, we have found that there is no material gain in the desirable characteristics of the cord produced, when the principles of the invention are employed in the spinning of the yarns forming the basis of the cord. That is, ordinary warp twist yarns of preferred grade and type of fiber spun under the normal conditions of twist and tension may be used for the basic yarns 25, Fig. 3. The essential advantages of the process accrue through its application to the operations of twisting the individual yarns into strands 26, and twisting these strands into a cable 27. Hence, while the scope of the invention includes its application to such formation of the basic yarns, the present exposition is directed more closely to the twisting of such previously-formed yarns into strands, and the combining of these strands into the cable or finished cord.

In accordance with the invention, the traveller 8 is of as light weight as is compatible with satisfactory winding of the strand or cable onto its bobbin or other carrier. This weight is determined by the conditions of temperature, humidity, speed of spindles, amount of fly, and other factors, and can be ascertained by experiment. The essential

point to be attained in lightening the traveller is the avoidance of all tension applied to the ends during the twisting and accompanying winding, greater than is necessary to achieve a uniform winding onto the bobbin. This reduced tension is less than can be employed on ring twisting frames as hitherto constituted and lacking our improvements, as pointed out hereinbefore. Under this relaxed tension, the strand or cable tends to close up its spirals, giving a spring-like elasticity, with superior stretch and recovery, and wound in relaxed condition into relatively soft bobbins as fast as twisted, this elasticity is preserved through absence of strain, instead of being taken out in large measure by the setting of the fibers during the period when the cord remains on its bobbin after being twisted and wound under the normal tension requisite for operating ring twisting frames hitherto.

It is well known in the art that with other factors equal, the strength of a yarn or cord is determined by the amount of twist put into it during its spinning or twisting. Thus, for a given type of yarn or cord, it has been found that a certain amount of twist gives the maximum tensile strength attainable under such equal conditions. This amount of twist, though varying as the conditions change, is sufficiently well established in practice to be accurately described by the term "normal twist." Putting into a yarn or cord an amount of twist exceeding the normal amount diminishes the tensile strength thereof as alluded to hereinbefore, though as stated, it is often resorted to to increase the elasticity of tire cords.

We have discovered that the insertion of the normal amount of twist under the described special conditions of relaxed tension, results in the attainment of elasticity fully as great as that secured at a sacrifice of tensile strength through overtwisting the cord, as often practiced. We have also found that with the use of the light traveller and consequent relaxed tension, the usual ratio of speed of spindle to rate of feed of the feed rolls must be changed, inasmuch as the strand or cable tends to be wound less rapidly upon the bobbin and hence tends to receive more turns of twist in its passage from the feed rolls to the bobbin. We have, therefore, increased the rate of delivery of the ends from the feed rolls until the twist inserted in an inch of strand or cable is equal to that found to give the maximum tensile strength.

Decrease in the weight of the traveller, augmented by the increased rate of feed from the feed rolls, causes a reduction in the tension to a point making the twisting operation unmanageable in the usual ring twisting frame, as referred to hereinbefore. To make possible the use of the familiar ring frame in carrying our invention into effect, we

have applied thereto means for regulating the balloon formed about each bobbin to keep such balloon within the limits defined by the relatively close spacing of the spindles. Such means comprise a rod 13 extending the length of each section of the ring twisting frame, supported upon the ring rail and travelling therewith. This rod is positioned at a proper height from the rail and at a proper distance behind the spindles to engage and restrain the balloon at the widest point thereof, at any time when the balloon attains sufficient size to endanger the balloons of adjacent spindles. In connection with this rod 13 there are provided shorter rods or fingers 14 projecting forwardly at right angles from rod 13 between each pair of spindles. Each finger 14 acts to confine and regulate the balloons of the two spindles between which it is located, restraining their size and keeping them from lashing and tangling with resultant breakage. Each balloon is accordingly confined between a pair of such fingers 14, which thus cooperate with the rod 13 on which they are mounted to restrain the growth of the balloon within the required limits imposed by the usual close spacing of the spindles.

The fingers 14 are provided at their rearward ends with hubs 15 fitting upon the rod 13, being secured in horizontal relation by clamping screws 16 threaded through said hubs and bearing against the surface of rod 13. The rod 13 is supported at intervals by members having lugs 17 through which the rod 13 extends and between which may be received the hub 15 of certain of the fingers 14, a clamping screw 18 being threaded through a portion of said members to bear against the hub 15 of the respective fingers 14 and clamp said hub and the rod 13 firmly within the member. A screw threaded shank 23 depends from the member 17 passing through a slot 19 in the angular bracket 20 which is bolted at 21 to the flange at the rear of the ring rail. The slot 19 provides for fore-and-aft adjustment of the whole balloon regulator to bring the rod 13 into proper relation with the balloons. The screw threaded shank 23 is equipped with lock nuts 22 permitting its being secured in the desired vertical relation with respect to the ring rail and consequently in the most effective position for regulating the balloons, such lock nuts also securing the balloon regulator in the desired fore-and-aft relation referred to. If preferred, the device may be arranged to have limited rotation within the lugs 17, to permit it to be tipped upward and rearward to facilitate doffing and donning.

With balloon regulators of this type, there is insufficient area for the accumulation of a harmful amount of grease or fly thereon to be subsequently picked up by the whirling

strand or cable to the injury of its quality, as is the case where an attempt is made to utilize the separators or anti-balloons of the types hitherto employed and which present a much larger area for contact with the balloons. Similarly there is no such mechanical injury occasioned to the whirling strands or cords in striking against the slender rounded surface of rod 13 and fingers 14, and a negligible amount of friction results from such contact to cause undesired increase in the tension.

An important feature of our improved method is that it greatly simplifies the production of a balanced elastic tire cord. When resort is had to overtwisting the component elements of a cord to give it greater stretch, as described in the patent aforesaid, it becomes much more difficult to balance accurately the cable twist against the reversely-directed strand twist so that the cord will have no tendency to twist and kink when unwound from its carrier. This balance is essential to satisfactory utilization of the finished cord, for if unbalanced the tire fabric made from these cords by arranging a great number in close parallel relationship will not lie flat when cut on the bias as is necessary, and the edges will curl up unmanageably and will fail to be seized and manipulated properly by the holding jaws of the automatic forming machines used in tire-building. Further, in making the so-called weftless cord fabric which has entered into widespread use, in which process the cord is unwound from large cones or tubes, unbalanced cord will kink occasionally and said kinks catch on the machines and break the cord, thereby causing stoppage of the weftless unit and consequent loss of production and increased cost.

When as in our improved cord only the normal relatively low number of turns of twist per inch is inserted in combining the yarns into strands, the fibers are not subjected to serious strain and act according to established and foreseeable principles, and the amount of recoil of the twisted strands in combining into a cable is easily ascertained in advance and accurately inserted in the reverse twisting or cabling operation. Thus the successive twists are easily balanced according to normal and well-known practice, and the resulting cord has no tendency to kink or twist, and fabric made from such cord will lie flat in easily handled relation.

The invention having been thus described, what is claimed is:

The method of making a cord for use in the manufacture of tires which consists in twisting a plurality of yarns to form strands and twisting a plurality of strands together to form a cord, the amount of twist imparted to the yarns and strands in forming the strands and cord being that required to impart maximum tensile strength, and simul-

taneously with the twisting of the yarns and
strands winding up the strands and cord
while in a relaxed condition under a light ten-
sion to impart and preserve elasticity in the
5 final cord.

In testimony whereof we have signed our
names to this specification.

KENNETH B. COOK.
LEO P. GERVAIS.

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