

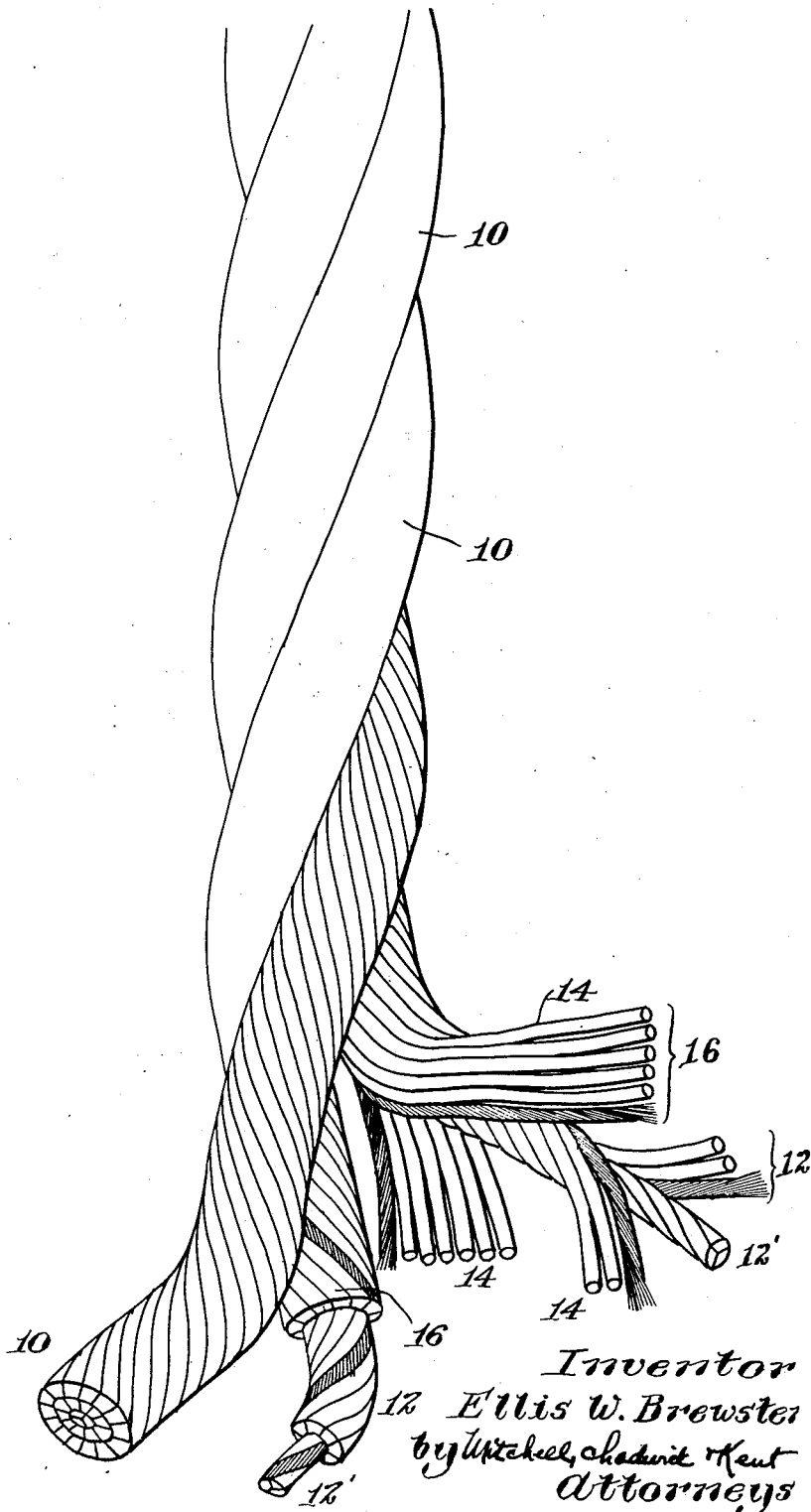
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ROPE

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UNITED STATES PATENT OFFICE.

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ROPE.

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This invention relates to improvement in rope. More particularly it provides an improvement in ordinary rope; that is, in rope consisting wholly of long and strong vegetable fibres such as hemp or sisal. The invention resides in the discovery of a particular arrangement of elements by which utility, strength, flexibility and durability are very considerably improved as compared with rope made from the same material according to standards generally accepted as good.

It is one feature that the invention permits of rope being made with a relatively softer lay, and therefore with greater strength, than heretofore, while maintaining in the strand a sufficient stability of form and a sufficient resistance to surface abrasion. In this respect the invention both prevents "back kinking", which is particularly liable to occur in a loosely laid rope, and provides greater strength per pound of hemp in the rope. It has been found in practice that such a rope has longer life, as compared with a rope of equal diameter but of standard construction, and that it retains greater strength than is customary with standard rope after any measure of service which may have been adopted for comparison. Also, for reasons which are incidental to its structure, the rope of the invention is easier to splice, is easier to handle when in service, and is subject to less liability of being damaged by unskillful handling as by being drawn from a coil in the wrong way. By its superior stability it enables the lubricant within it, the strength of fibre, and the other characteristics of the rope to perform their several functions to better advantage, thus insuring that at any particular instant a rope thus constructed will be in better condition than a rope of former standard construction would be, for whatever service may be demanded of it.

These objects are attained by putting the strands together with a relatively soft lay, in making the rope, and arranging yarns in a special manner in the strands, the yarns being made from hemp or other long fibre in the usual way. The said arrangement is that some of the yarns constitute a core and others of them a cover for the core, with the yarns in the core laid in a different direction from the lay of the yarns in the cover. Prefer-

ably also the twist of the individual yarns in the cores is opposite to the twist of the individual yarns in the covers. The pitch of yarns in core and in cover may be equal or diverse, but the difference in direction of lay prevents the outside yarns from ever being drawn into the valleys between yarns of the core when a finished rope is twisted reversely. As neither untwisting nor further twisting of such a soft laid rope will seriously disturb the structure of any of the strands, the rope can easily resume its normal structural form after any such chance twisting. The individual twist of the yarns at the surface can be as hard as desired.

It is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty exist in the invention disclosed.

In the drawing:

The figure is a side elevation of a rope embodying the invention with one end unlaid to indicate construction, and the relations of fibres and yarns within.

Referring to the drawings, the three strands 10 of the specimen rope chosen for illustration are laid together by twisting them in ordinary manner, except that the lay is preferably soft, that is, with a pitch longer than what has hitherto been considered normal or necessary for the particular size and kind of rope. Each strand 10 is homogenous, in that it is composed wholly of long vegetable fibres, such as hemp. These fibres are grouped in yarns 14 which are individually twisted. As illustrated in the figure the yarns in each strand are arranged in two groups, one of which, 12, including 12', is twisted as a group in one direction, herein being called a core, while the other, 16, herein called a cover, is laid in a sheath around the core 12 in a direction opposite to the twist of the core. Preferably the relative pitch of these two twisted groups may be such that when the rope is stretched the fibres in each group will reach their breaking tension at about the same distance of stretch of the rope as a whole. The described construction provides a rope which has in the interior of each strand a substantial body 12 of yarns with lay in the same direction as the lay of the strand in the rope; and has exteriorly in each strand a body of cover yarns whose lay everywhere

crosses the lay of the core yarns and is opposite to the lay of the strands. When the rope is put into use and by tension is stretched, the tightening of the cover yarns may compress the core severely. But the core affords a firm resistance, being of the same substantial sort of fibrous material as is the cover; and with the continuance of stretching the yarns of cover and core cooperate without such serious difference between them as would cause a larger proportion of the stress than is its proper share to become borne by either group, and without allowing the tightened cover yarns, any of them, to sink into the mass of the core, as might happen if the core were made of softer material, or if though made of the same material as the cover were laid in the same direction as the cover, or as might happen if the core were made of the same material as the cover but with yarns laid parallel and straight. In the last mentioned case the core yarns would become taut and would break before the cover yarns had reached their breaking stress producing a rope of weak ultimate strength. And in the case where all yarns in a strand are laid in a like direction, any untwisting of the rope such as sometimes arises in handling or in use, might so tighten the twist of the cover yarns, upon their core, as to draw some or other of the outer yarns in between adjacent core yarns with which they are lying parallel. This makes "back-kinking" which is a serious evil because it spoils the rope, and which is always possible in ordinary rope because when outer and inner yarns are laid in the same direction back twisting of the rope as a whole tightens the outer yarns more than it does the inner yarns per degree of angular rotation in the twist applied. The danger of such back-kinking is one reason why the lay of ordinary rope is made so tight, and why it cannot safely be made more "soft" as would be desirable in order to utilize a greater proportion of the strength of the fibers. But in a rope of the invention each strand has permanent stability of form notwithstanding severe untwisting of the rope, and notwithstanding abnormal twisting of it, for no amount of twisting or untwisting can move any yarn in the cover of the strand so that it comes into parallelism with the valley between two adjacent yarns in the core thereof. The cover yarns inevitably pass from crest to crest of the outer yarns of the core. However tight the cover yarns be drawn by an untwisting of the rope, or however much they be relaxed by a twisting of the rope (which act holds the core yarns the more firmly in shape) they are in each case sustained on this interior support of rounded crests. Other advantages follow. Thus, a surface of cleavage whereon slip can easily occur, and which may if desired be

specially lubricated, is provided in the midst of each strand, and this makes for flexibility of the completed rope. Inasmuch as the cover yarns are firmly binding the core yarns in their laid relations, the core yarns do not have to be twisted so tightly in order to hold themselves in proper position. Therefore they can, if desired, run with less pitch, more nearly longitudinally of the rope; or they may, as shown, be of a pitch approximating equality with the pitch of the cover yarns; or they may have greater pitch. The yarns 14 are represented as being individually twisted all in one direction in the core 12, and all in the other direction in the cover 16. The interior group of yarns 12' in the core is preferably twisted with the group of core yarns surrounding it, as in the case illustrated all of them together do not make as many yarns as are in the cover. This, however, is a matter to be given consideration when any particular rope is designed, and if the interior body 12' were so large that the dangers indicated above were liable to arise, the remedy indicated herein should be applied by reversing their direction of lay with respect to the outer yarns 12 of the core. In case of a strand having such a second reversal of direction of lay for its interior yarns, those yarns which constitute the outside layer of the core make a slip cover or sheath over the said reversed yarns within them, and a second surface of cleavage between yarns is thus provided, enhancing flexibility of rope and, as above described, further preventing any back kinking arising by inter-engagement of interior yarns in case the rope as a whole is untwisted.

In the making of the rope the yarns 14 are made according to ordinary methods of such material or mixture and of such size and degree of twist as may be considered desirable; and then for the making of the core 12 a bundle of such yarns is twisted, so that its yarns are, for example, laid to the right, using machinery of any suitable type operating upon principles already known. Over this core the cover yarns are laid in the opposite direction. For ordinary purposes this would complete a strand 10.

The three strands 10, or whatever other number of strands is to be used, may then be twisted together to make a rope in the usual manner, preferably laid at a pitch which is longer than what is considered safe and necessary in rope made for the same duty but of the type at present standard in the rope industry.

This softness need not result in danger of greater surface abrasion, for the cover yarns may be made with individual twist hard enough to resist such.

Nor need the softness of lay result in a slipping between fibres of the core and a

failure of the rope for that cause when under severe stress. A holding friction between fibres is developed by the sub-division of the core into yarns individually twisted, and is maintained more effectively, and is disseminated throughout the whole body of the core, by a less intense constriction of the cover than if the fibres of the core lay all in parallelism with each other in one large mass. The force imparted at the surface of the core by the constriction of cover yarns upon it is transmitted throughout the core more readily in a case, as here, where a concentration of the core can occur by slight cross slip of yarn upon yarn, laterally, and then the frictional holding of fibre upon fibre, increased by this concentration, is aided by the local twist of the fibre in its own yarn, all tending to prevent the fibres from slipping longitudinally upon its adjacent fibres. Thus each fibre becomes capable of contributing to the rope whatever strength it has regardless of slip or weakness which may occur in some other part of the core. This point being safeguarded it follows from the greater length of pitch of strands (softness of lay) which thus becomes permissible that the resultant or average lines of all fibres and yarns become more nearly parallel to the axis than in the type of rope prevailing hitherto. Therefore, when the rope of the invention is under tension, the stress of fibres resulting from a given total tension is less than is the stress of fibres in a rope of ordinary construction, wherein the angle of strands to the axis is greater. And this produces the consequence that the new rope as a whole in a given duty puts less torsional stress on its fibres, and is stronger, size for

size, besides having greater flexibility, and being secure against kinking. By way of confirmation of this and as a further advantage, it has also been observed that experimental rope, embodying the invention and used for certain work through a period equal to the life time of an ordinary rope in that service, is at the end of the period still in good condition.

I claim as my invention:

1. A rope composed of a plurality of strands twisted together, each of said strands having a core of yarns of long vegetable fibres, said yarns being twisted together, and a cover of yarns of long vegetable fibres laid around the core in direction opposite to the twist of the core.

2. A rope composed of a plurality of strands twisted together, each of said strands having a core of yarns twisted together and a cover of yarns twisted around the core in direction opposite to the twist of the core; the said yarns in core and cover being severally composed of long vegetable fibres twisted together to make the several yarns; the twist of individual yarns in the core being opposite in direction to the twist of individual yarns in the cover.

3. A rope composed of a plurality of strands twisted together, each of said strands comprising a twisted core of fibres with a cover of yarns laid around said core in the direction opposite to that of the twist of the core, the kind of fibres being homogeneous in core and in cover.

Signed at Plymouth, Massachusetts, this tenth day of January, 1927.

ELLIS W. BREWSTER.