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CORDAGE AND METHOD FOR PRODUCING THE SAME

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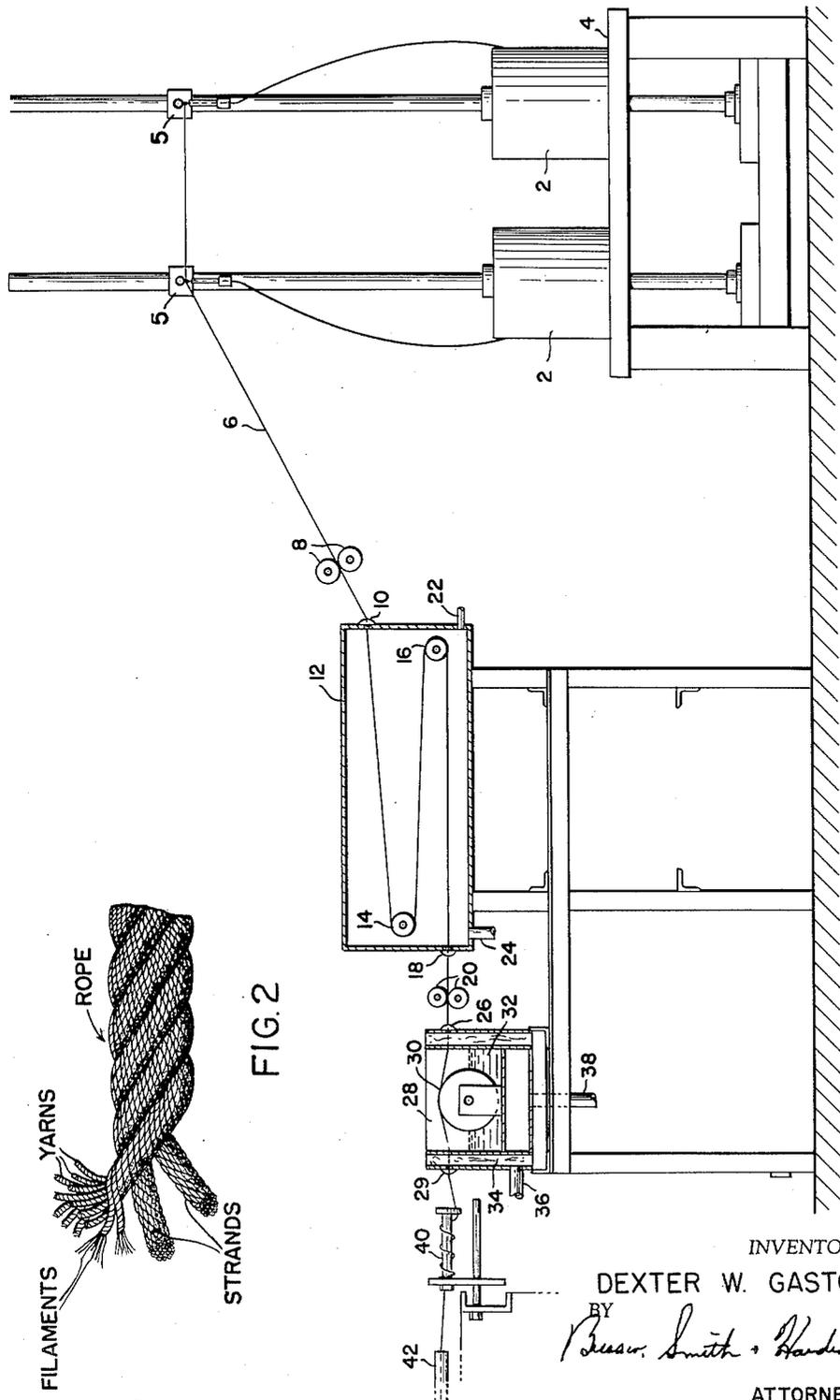
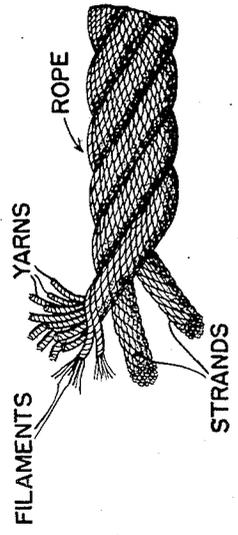


FIG. 1

FIG. 2



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CORDAGE AND METHOD FOR PRODUCING THE SAME

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This invention relates to cordage and method for producing the same, and has particular reference to cordage formed of synthetic thermoplastic filaments such as those of nylon, Dacron, or the like.

The problems solved in accordance with the present invention are best exemplified by consideration of rope made from nylon. Nylon shrinks to a total extent of about 8½%, and 6% shrinkage may well be expected in the case of nylon rope in use when subjected to summer heat and sunlight. In the case of Dacron in certain environments, e.g. at high temperatures, the total shrinkage may be expected to be 11 to 12%. The result of this situation is that if nylon rope (or other synthetic thermoplastic rope) is initially formed to provide a satisfactory rope when first made, it shrinks during use and hardens to such degree as to be quite unsatisfactory. In contrast, if it is initially twisted in order to anticipate shrinkage it will be initially too loose and consequently unsatisfactory.

In accordance with the present invention a rope may be made firm enough to maintain its structural shape and yet not harden to the point where it becomes objectionable in use. As made in accordance with the invention the rope will still shrink enough to offset most of the softening effect resulting from extension under heavy loads. It is made sufficiently soft to absorb backtwist without hockling.

In accordance with the invention, there is provided a rope which has built-in ability for each element of the rope structure to adjust itself in use before the rope becomes too hard and locked up to the point where further adjustment is impossible.

In brief, the invention involves taking out part, and only part, of the expected shrinkage of the raw material, so that when the material is finally assembled into a rope structure, only part of the shrinkage remains. As the rope tends to stretch in use, the residual shrinkage left in the material compensates for this stretch so that the resulting product after use has essentially the same properties as when it was originally manufactured. The attainment of the foregoing will become apparent from the following description read in conjunction with the accompanying drawing in which:

FIGURE 1 shows in diagrammatic elevation a type of apparatus capable of producing the desired results; and

FIGURE 2 is a side elevation of a section of a three stranded rope made in accordance with this invention, the end of the rope being partially untwisted to illustrate the yarns.

Considering, specifically, the formation of nylon rope (to which the invention is primarily applicable), the raw material is provided from supply packages indicated at 2 supported on a table 4. There may be any desired number of these from which the multiple filaments are guided and assembled through guide means indicated at 5 to pass together at 6 to the treating apparatus. The feed may be, in some cases, controlled by capstans 8 driven in suitable fashion, though these capstans may be omitted as will be hereafter discussed. The raw material may be in the form of so-called nylon "ribbon" in which the multiple filaments are either not twisted together or have applied to them only a "false twist" for ease in original packaging,

the twist in the latter case being very loose. The multiple filaments then pass through a guiding opening 10 into a chamber 12 within which they pass in zig-zag fashion about guide rollers 14 and 16, finally emerging through an opening 18 and passing, if desired, to capstans 20 controlling the rate of feed. The chamber 12 receives steam introduced at 22 and exhausted at 24, there passing out at 24 condensate as well as steam which may not be condensed.

The multiple filaments then enter a guide opening 26 in the wall of a receptacle 28 emerging through a guide opening 29. Within the container 28 is a cylindrical roller 30 in contact with which the filaments pass to effect rotation of the roller within a supply 32 of lubricant which may be of conventional type comprising, primarily, wax which is maintained in molten condition by a steam jacket 34 to which steam is admitted at 36 and from which it is exhausted at 38.

From the guide opening 29 the filaments pass helically about a fixed rod 40, then passing to the conventional twist tube 42 of the usual yarn forming mechanism which operates by twisting the filaments to the desired extent. The lubricating arrangement and what follows it in the direction of feed are conventional and form, per se, no aspect of the present invention. The rod 40 prevents the twist from following backwardly into the lubricant applying means so that as the filaments move over the roller 30 they remain spread apart so as to receive an adequate and proper amount of lubricant. This same condition of the filaments being spread apart exists in the chamber 12 so that they are individually adequately subjected to the action of steam.

The operations following the formation of the twisted yarn are conventional, strands being provided either from a single yarn or a number of yarns, for example, three, in the latter case for the formation of plied rope. Finally, the strands are twisted to form rope in conventional fashion, as is illustrated in FIGURE 2.

The object of passing the filaments of raw material through the chamber 12 is to effect a desired amount of shrinkage in the raw material. In this action, time, temperature and tension are factors.

In a typical operation, assuming that no capstans are provided at 8 and 20, the nylon filaments may be within the chamber 12 for periods of time of the order of 2 to 4 seconds. With the capstans omitted the filaments are under very slight tension and if subjected to steam at temperatures in the general range of 212 to 215° shrinkage may typically occur to the extent of 3 to 4%. While it will be evident that the ranges of time and temperature may vary considerably, the conditions just indicated give rise to final ropes which have the satisfactory properties above indicated as desirable. The partial shrinkage of the raw material which is thus produced permits the twisting of the rope to be carried out to provide a rope which is satisfactory initially while at the same time a rope is provided in which further shrinkage during use is compensated by stretch occurring during use to the extent that the rope maintains its desired properties throughout its life, never being too loose nor becoming too tight or hard.

While operation without capstans as just described is highly satisfactory with most available nylon raw material, there may be precise control of shrinkage afforded by the use of capstans at 8 and 20 driven at feeding speeds properly related to each other. By, for example, feeding into the chamber 12, 4% more length of the filaments than are withdrawn from the chamber the shrinkage, despite subjection for longer times and at higher temperatures, will be limited to 4%. This percentage is given by way of example only, since the percentage shrinkage which is

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desired will depend upon the use to which the rope is ultimately to be subjected, the object being to provide for a possibility of further shrinkage to the extent of the expected extension which will occur in use. For nylon it may be estimated that the total shrinkage will be about 8½%, while the elongation resulting from tension during use may be of the order of 4 to 5%. Instead of using capstans, other tensioning devices, such as spring pressed discs or the like may be used. It will be understood that tensioning ranging upwards from substantially no tension may be used depending on the characteristics of the raw material and the expected conditions of use of the final rope.

In the case of Dacron or other thermoplastic filaments the amount of shrinkage which is desired depends upon the characteristics of the material and the expected use of the rope. For example, Dacron will shrink to a total extent of 11 to 12% under temperature conditions exceeding about 140° F., and the partial shrinkage in the chamber 12 may be carried out to an extent to correspond to this and the expected elongation under stress when conditions of shrinkage may be involved in use of the final rope.

While the invention is applicable to the treatment of the raw filaments for twisted rope it is also applicable to treatment of raw material for the formation of braided ropes.

Different groups of filaments, or the filaments forming particular strands, may be subjected to different degrees of partial shrinkage to produce special properties in the final ropes. In a large rope the center yarns or plies take the major part of the load, the load being less for the outer cover yarns or plies. In the case of nylon the outer yarns will shrink more than inner yarns due to exposure to the weather. To take care of these situations differential shrinkage may be adopted. As a specific example of this the inside yarns or ply elements may be shrunk to a greater extent than the outside yarns or ply elements, the more the shrinkage involved, the greater being the extension which may occur under load. This overcomes the so-called serigraphic effect. In other words, the serigraphic effect may be treated in desired fashion to attain desired results in the final rope.

It will be clear that, if desired, final so-called stabilization may be effected by treatment of the final rope in boiling water, though that is generally not desirable in the case of ropes made in accordance with the foregoing.

It will be clear that various changes may be made in the processing without departing from the invention as defined in the following claims.

What is claimed is:

1. The method of making rope of thermoplastic filaments comprising subjecting the filaments prior to the formation of strands to a partial shrinkage by the application of heat to leave in the filaments the capability of further shrinkage to an extent approximating expected elongation due to stress during use of the final rope form-

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ing strands from said treated filaments, and forming rope from said strands.

2. The method of making rope of thermoplastic filaments comprising subjecting the filaments prior to the formation of twisted yarn to a partial shrinkage by the application of heat, the amount of said partial shrinkage of said filaments being such that the remaining possible shrinkage of said filaments approximates the expected elongation due to stress during use of the final rope forming strands from said treated filaments, and forming rope from said strands.

3. The method according to claim 1 in which the thermoplastic filaments are of nylon.

4. The method according to claim 2 in which the thermoplastic filaments are of nylon.

5. Rope composed of strands composed of thermoplastic filaments in which the filaments prior to being formed into rope have characteristics resulting from their having been partially shrunk to leave in the filaments of the formed rope capability of further shrinkage to an extent approximately that of expected elongation due to stress during use of the rope.

6. Rope according to claim 5 in which the filaments are of nylon.

7. The method of making rope of thermoplastic filaments comprising subjecting the filaments prior to the formation of strands to a partial shrinkage by the application of heat while maintaining said filaments under tension, the amount of said partial shrinkage of said filaments being such that the remaining possible shrinkage of said filaments approximates the expected elongation due to stress during use of the final rope, forming strands from said treated filaments and forming rope from said strands.

8. The method of making rope of thermoplastic filaments comprising passing the filaments rapidly and continuously through a heating chamber to partially shrink said filaments, the amount of said partial shrinkage of said treated filaments being such that the remaining possible shrinkage of said treated filaments approximates the expected elongation due to stress during use of the final rope, forming strands from said treated filaments and forming rope from said strands.

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