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3,264,022

METHOD OF FORMING A KNOT

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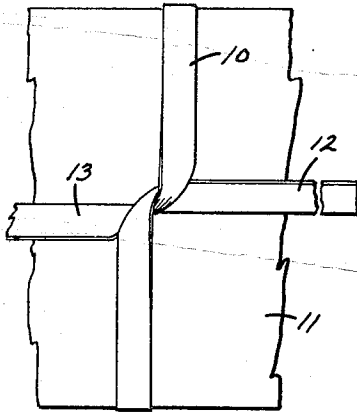


Fig. 1

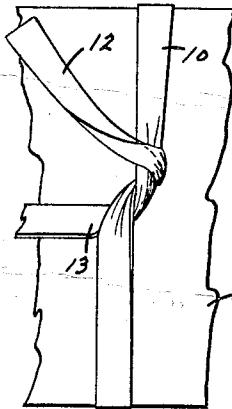


Fig. 2

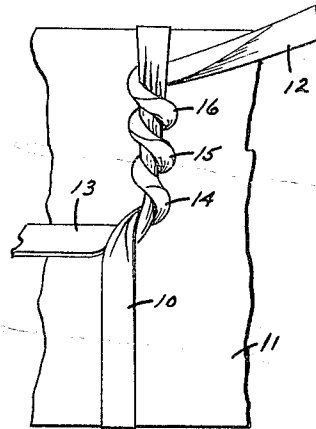


Fig. 3

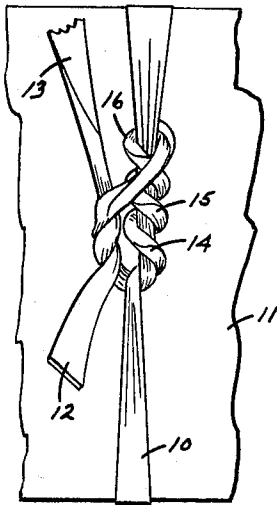


Fig. 4

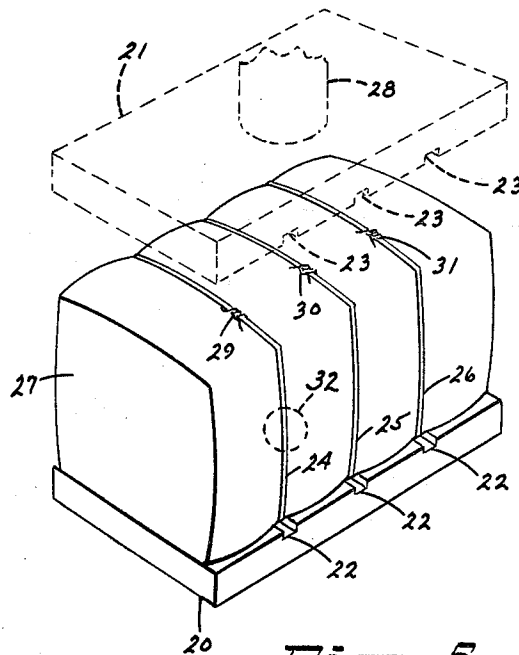


Fig. 5

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This invention relates to a knot for uniting opposite ends of a strand of ribbon-like material, particularly high strength ribbon-like material which is subjected to high tension forces. The invention also relates to a method of securing a bale tie about a compressed bundle in such manner that the securing means is subjected to a minimum amount of tension.

When two ropes or strands or opposite ends of a single rope or strand are secured together by means of a knot, the over-all strength of the strand is lowest in the knot area. Over the years, in fact for centuries, literally hundreds of knots have been devised and while the aim has often been to provide a knot which was decorative or which could be easily tied or readily untied, many efforts have been directed toward providing a knot of maximum strength. However, no knot has been devised which is as strong as the unknotted strand and where maximum strength is essential splicing is resorted to, but splicing is time-consuming.

The art of knot tying has developed primarily in conjunction with strands of substantially circular cross-section and when dealing with ribbon-like strands of rectangular cross-section the aim has generally been toward knots which are decorative, since the ribbon-like material was not intended to withstand large forces. In U.S. Patent No. 3,028,281 there is disclosed a ribbon-like strand structure capable of withstanding extremely high tensile force, thus making it ideally suited for a bale tie, among other uses. While the strap or ribbon of Patent No. 3,028,281 is sufficiently flexible both longitudinally and transversely to permit it to be tied into a knot, high-strength knots developed for circular cross-section are not generally suitable, without modification, for use with a structure of this nature.

Even though a knotted strand is weakest at the knot, it is sometimes possible, by judicious positioning of the knot, to utilize substantially the full unknotted strength of the strand. For example, in some types of baling operations the bale tie is under considerably more stress in certain areas than in others and by locating the knot or other securing means in an area of relatively low stress, the full strength of the bale tie, be it cordage, band or wire, may be used in the high stress areas.

It is an object of the present invention to provide an improved high-strength knot and method of tying the same in two end portions of ribbon-like material.

It is a further object of the invention to provide a high-strength knot which can be tied with facility in a ribbon-like strand even when only one free end of the strand is available for manipulation.

A still further object of the invention is to provide a high-strength knot for a ribbon-like strand which permits the strand to be drawn tight about an object before final closure of the knot.

Another object of the invention is to provide a method of baling which minimizes the forces on the knot or other securing means of the bale tie.

Other and further objects, features and advantages of the invention as well as the means of attaining the same will become apparent as the description thereof proceeds.

Referring now to the drawing:

FIGS. 1 through 3 show the preliminary steps in forming the novel knot;

FIG. 4 is a plan view of the completed knot showing

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the condition of the knot prior to being placed under tension; and

FIG. 5 is a perspective view illustrating the novel method of securing bale ties.

As previously mentioned, the knot of the present invention is advantageously used with a high-strength ribbon-like strand such as described in U.S. Patent No. 3,028,281. While the strand of the patent consists of a plurality of high-strength cords adhesively secured in side-by-side relationship, the knot of the present invention may also advantageously be used with a woven ribbon-like strand and, in fact, with any flat strand having sufficient flexibility to permit it to be folded or rolled about its longitudinal axis.

In FIGS. 1-4, the strand is indicated at 10. Strand 10 is passed around a bundle or bale 11 and, as shown in FIG. 1, the free end portion 12 of the strand is then passed over and under the other end portion 13 which may also be a free end or may extend to a supply such as a roll, not shown. The thus crossed ends may then be pulled in opposite directions to tighten the strand about the bundle. In order to simplify and clarify the description, the term "end portion" is used hereinafter to designate the strand in the vicinity of the knot and not just the actual tip end of the strand. Thus, in FIG. 1 end portion 13 extends somewhat above the crossover.

After the end portions of the strand are crossed, the free end portion 12 is then wrapped at least twice around the end portion 13 and simultaneously with the wrapping, end portion 12 is twisted about its longitudinal axis to thus convert the said end portion from a flat ribbon-like configuration into substantially cylindrical formation. This twisting of the end portion 12 serves two very important functions. First, it provides a bulkier knot which minimizes sharp bends which would weaken the knot; and second, the length of end portion 13 which is covered by the wrappings or loops is less than when the strand is not twisted. End portion 12 should be wrapped around end portion 13 at least twice and preferably it is wrapped around three times to form three loops 14, 15 and 16, as illustrated in FIG. 3. More than three loops may be provided but for maximum knot strength it is desirable that the rightwardly extending part of end portion 12 in FIG. 3 be kept fairly close to the leftwardly extending part of end portion 13. If these end portions are far apart when the final knot closure is made, that part of end portion 13 which is covered by the loops is subjected to severe bending which weakens the knot in this area. In FIG. 3 the loops 14, 15 and 16 are shown spaced apart in order to clearly show the knot structure but in practice they are located close together, thus covering only a short length of end portion 13.

The twisting of end portion 12 during the formation of the loops is very easy to accomplish and, in fact, takes place naturally when the flat strand is gripped firmly between the fingers while wrapping it about end portion 13. One turn of twist for each loop is sufficient to convert end portion 12 into substantially cylindrical form and conveniently said end portion is twisted in the same direction that it is wrapped. Thus, when end portion 12 is wrapped clockwise it is also twisted clockwise and vice versa.

After the desired number of loops have been formed, the two end portions 12 and 13 may be pulled in opposite directions to further tighten the strand about bundle 11 prior to closing the knot. As shown in FIG. 4, the knot is closed as a square knot by passing end portion 12 across above and then across beneath end portion 13 and drawing the end portions tight. If end portion 13 is a free end, the knot may be closed by doubling both ends back upon themselves and passing each over and under the other.

The above-described knot is ideally suited for securing

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bale ties inasmuch as the loops 14, 15 and 16 permit some slippage of end portion 13 therethrough to absorb the initial bale pressure when the bale is released from the action of the press. The actual amount of initial slippage depends largely upon how tightly the loops 14, 15 and 16 are drawn prior to closing the knot and thus by drawing these loops tight the knot is useful under circumstances where slippage should be avoided.

Referring now to FIG. 5, the platens of an open-sided baling press are indicated at 20 and 21. Such presses are widely used for baling greige goods, old newspapers and other sheet-like articles which when compressed do not bulge sideways and therefore do not require a closed press. Platens 20 and 21 are provided respectively with bale tie accommodating slots 22 and 23 and the bale ties, indicated at 24, 25 and 26, extend through these slots when the bale 27 is under the pressure of the platens. Platen 21 is movable up and down by a plunger 28 to compress and release the bundle. The ties may be laced through the slots of the platen and about the bundle in any of several known ways, either before or after the bundle is compressed.

If the bale ties are formed of the ribbon-like material of the above referred to Patent No. 3,028,281, or some other similar material, they may be secured by means of the above-described knot and in FIG. 5 the knots are indicated at 29, 30 and 31. According to the present invention, the knots are tied, as is conventional, along one of the sides of the bundle 27 not engaged by either of the platens 20 and 21. For example, knot 29 may be tied in the vicinity of the area designated by the dotted-line circle 32. Of course the knots are tied while the bundle is under pressure. Normally, the knots would remain in the area in which tied but according to the present invention, after the knot is tied and before the compressive force of the platens is released the bale tie is slipped about the bundle to position the knot on a face of the bundle engaged by one of the platens. The slots in the platens permit this movement of the bale ties. When platen 21 is raised, the bale attempts to expand vertically and this places great stress on the bale ties but by far the greatest tension is imposed on the vertical runs of the ties. The reason why the ties are not under equal tension all the

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way around the bale is that the edges of the bale provide a substantial snubbing action on the tie passing therearound. By thus positioning the knot or other securing means on an area of relatively low tension, the full strength of the unknotted bale tie is utilized in the high tension areas along the sides of the bale and the fact that the knotted portion of the tie is not as strong as the unknotted portion is not of practical significance.

Another real advantage in positioning the knots on a face of the bale engaged by one of the platens is that as the bale attempts to expand the ties become indented into the faces formerly engaged by the platens so that if the bale is slid along a conveyor or rolled across the floor, the knot is protected by the bulging parts of the bale.

Having thus described the invention, what is claimed is:

1. A method of forming a knot in two end portions of a relatively stiff ribbon-like material comprising the steps of wrapping a first end portion about the second end portion at least twice while simultaneously twisting the said first end portion about its longitudinal axis, and then tying said end portions together.

2. The method set forth in claim 1 wherein the first end portion is twisted once each time it is wrapped about the second end portion.

3. The method set forth in claim 2 wherein the twist direction is the same as the wrap direction.

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