

[54] ROPE FITTINGS

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24/136 L

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[57] ABSTRACT

Simplified means for terminating fiber ropes comprising a conical member and a tapered socket therefor, the taper of each being such as to produce substantially constant annular area therebetween equal to the total cross-sectional area of the rope and the cone angle of the conical member being less than the natural angle of friction between the member and the rope fibers.

8 Claims, 3 Drawing Figures

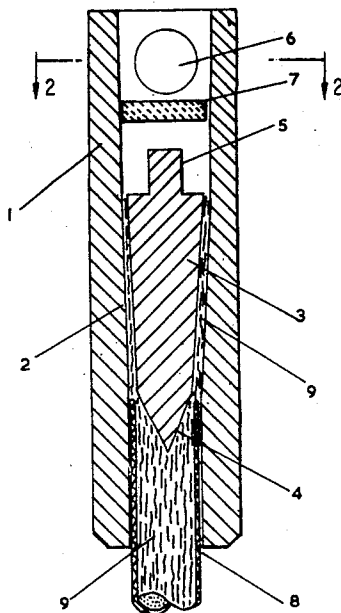


FIG. 1

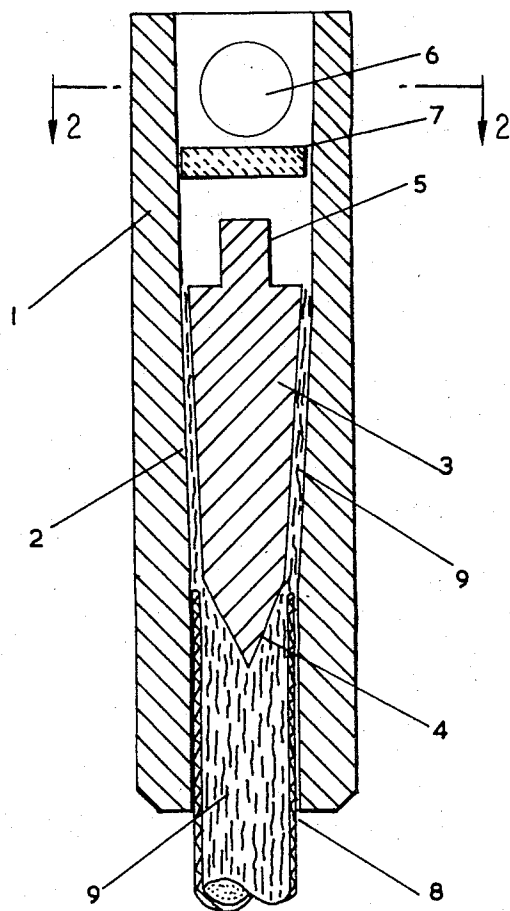


FIG. 2

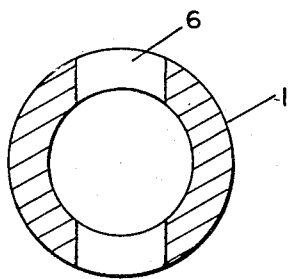
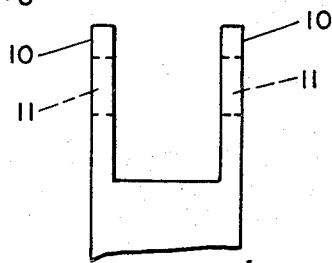


FIG. 3



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ROPE FITTINGS

This invention relates to rope fittings and in particular to means for securing fiber ropes to a fixture as for example a deck bolt or a stay anchorage.

It is difficult to terminate fiber ropes, particularly ropes comprising a core of parallel filaments encased in a sheath of thermoplastic material, so that the rope end may be attached neatly and efficiently to a fixture. Various methods have been proposed or used for this purpose, as for example, carrying the ends of the rope around a sheave and swaging a ferrule about the free end and the standing end in a hydraulic press or by using a special fitting such as is described in U.K. patent specification No. 1,139,841 comprising a conical socket and a double cone insert and collar around which the filaments are spread. The former method is cumbersome in that it necessitates the preparation of swaging dies and the use of an hydraulic press. The latter method although very effective requires a more complicated fitting and a certain degree of skill in the fitting operation.

We have now found that fiber ropes, particularly but not exclusively ropes comprising a core of parallel filaments encased in a sheath of thermoplastic material, may be effectively secured by simplified means having only two parts.

Thus according to this invention we provide a means for terminating an end of a fiber rope comprising a socket at least part of the inner wall of which is tapered, a conical member fitting within the socket so as to provide a space between the tapered inner socket wall and the surface of the member of substantially constant annular area equal to the total cross-sectional area of the fibers in the rope end, the included cone angle of the conical member being less than the natural angle of friction between the material of the conical member and the fibers.

Also according to the present invention we provide a method for terminating an end of a fiber rope comprising positioning a socket about the end of the rope, distributing the fibers of the rope end about the inner wall of the socket which wall is tapered and narrows towards the end through which the rope end is inserted and retaining the fibers therein by driving into substantially the center of the distributed fibers the apex of a conical member until said member is at least partly embedded in the fibers within the socket.

The term fiber rope as used herein means a rope made of natural or synthetic fibers or mixtures thereof, in staple fiber or continuous filament forms and includes both ropes of the conventional twisted structure and ropes comprising a core of substantially parallel continuous filaments as for example poly(ethylene terephthalate) filaments encased in a sheath of thermoplastic polymeric material. In terminating a rope of twisted structure the rope end is untwisted and the fibers loosened so as to be easily distributed about the inner tapered surface of a socket. In terminating the sheathed type of rope a section of the sheath at the rope end is first removed, insufficient to expose the filaments outside the socket when the termination is complete.

The term natural angle of friction as used herein has the accepted meaning as expressed by the relationship:

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$$\mu = \tan \phi$$

where μ is the coefficient of friction between the material of the rope fibers and the material of the inner cone member and ϕ is the natural angle of friction.

In preparing or selecting a terminator for a particular fiber rope ϕ is first determined and then the included cone angle of the inner cone member is selected to be less than this value, preferably at least about 10 percent less. The inner cone member is preferably of right circular form and the tapered portion of the socket of the same form but of a smaller included angle in order that the area of the annulus between the two conical parts is substantially constant over their whole length and equal to the total cross-sectional area of the fibers in a rope end. Juxtaposition of two right circular conical parts in this fashion does not give exactly constant annular area over the whole length, there being a small departure from precise constancy amounting to only a few percent of fiber area towards the cone apices which is without practical effect on the efficiency of termination.

The length of the conical parts is substantially greater than the diameter of the rope but is preferably no greater than that necessary to provide an adequate wedging action to utilize substantially the full strength of a rope. The preferred minimum length may be calculated from the total cross-sectional area of the fibers in a rope end by means of the following empirical relationship;

$$L = 6D$$

where L is the minimum length of the conical parts and D is the equivalent diameter of a circle having an area equal to the total fiber cross-sectional area, the values of L and D being expressed in the same units.

Use of a minimum length as calculated by this relationship also ensures that minimum shear stresses are induced in the filaments or fibers of a rope and hence that the possibility of fiber or filament breakage or damage is also minimized.

The invention will be further understood from the following detailed description taken with the drawing in which:

FIG. 1 is a longitudinal sectional view of a rope fitting embodying the principles of the present invention;

FIG. 2 is a sectional view taken on the line 2—2 of FIG. 1; and

FIG. 3 is a fragmentary view of a modified form of fitting.

In FIG. 1 a socket 1 externally of cylindrical form has an intermediate portion 2 of an inner wall of tapered form, the included angle of the conical part so formed being smaller than the included cone angle of the main body of a conical member 3 which fits inside the socket with a small annular space therebetween as hereinbefore described. The apex 4 of member 3 is of smaller included angle than the body thereof and the base of member 3 is formed into a cylindrical projection 5 which serves to assist insertion of 3 into the socket and to limit the driving force which may be applied thereto. The upper and lower parts of the inner wall of the socket 1 are of cylindrical form the diameters of which are respectively equal to the upper and lower diameters

of the tapered part 2. A pair of diametrically opposed apertures 6 are formed in socket 1 for attachment of a pin or shackle or other mounting means. A small plug 7 may be inserted into the upper cylindrical part of socket 1 to close off the fiber cone after the termination process has been completed.

In carrying out the termination process with a rope of the kind illustrated in the drawing a section of sheath approximately equal to the length of the main body portion of member 3 is removed from the rope end 8 after this has been inserted in the lower end of socket 1. The rope 8 is drawn into the socket 1 until the end of the sheath is about level with the lower end of the tapered portion 2 and the filaments 9 of the free end are distributed as evenly as possible around the tapered portion 2. The apex 4 of a conical member 3 is then inserted into the center of the fiber mass and driven down until tightly wedged at which point the tapered apex 4 should have penetrated into the sheathed portion of rope 8. A plug 7 is finally pushed home against the top of member 3 to seal the unit.

For adequate strength a socket is preferably made of steel or similar metal such as brass or stainless steel if corrosion resistance is desired. An inner cone member is conveniently made from a polymeric material as for example nylon 66 or polyethylene terephthalate. Such members may be formed in quantity by injection moulding.

In a typical example of a terminator as shown in the drawing for a rope comprising a core of 19,200 polyethylene terephthalate filaments having a total denier of 10^6 encased in a polyethylene sheath a steel socket measures only 6 inches in overall length and 1.5 inches diameter. The main body of the inner member made of nylon 66 is 2 inches long and of included angle 5° . As a rope of this size and kind will have a breaking load of about 5 tons it is seen that a fitting according to this invention is small and neat. It is in addition highly efficient in preventing fiber slippage when placed under high tension and allows substantially the full rope strength to be available in the terminated structure as soon as the inner cone member is driven home.

Alternative to the cylindrical upper part of a socket having apertures 6, this part as shown in FIG. 3 may be formed as two lugs 10 having apertures 11 which may then allow attachment of the socket to a single lug in place of dual shackles which may otherwise be necessary.

Optionally the lower part of a socket may have a channel or groove cut in the inner surface close to the end in which a resilient sealing ring may be fitted if more complete sealing of the exposed end of a rope within the socket is desired.

We claim:

1. A means for terminating an end of a fiber rope comprising a socket at least part of the inner wall of which is tapered, a conical member fitting within the socket so as to provide a space between the tapered inner socket wall and the surface of the member of substantially constant annular area equal to the total cross-sectional area of the fibers in the rope end, the included cone angle of the conical member being less than the natural angle of friction between the material of the conical member and the fibers and the lengths of the tapered parts of the socket and the conical member are greater than the diameter of the rope.

2. A means as in claim 1 wherein the lengths of the tapered parts of the socket and the conical member are at least $6D$, where D is the diameter of a circle of area equal to the total fiber cross-sectional area.

3. A means according to claim 1 wherein the upper end of the socket is substantially cylindrical and has transverse apertures therethrough for attachment by shackle means to a fixture.

4. A means according to claim 1 wherein the upper end of the socket is formed into two lugs having apertures for attachment by mounting means to a fixture.

5. A means according to claim 1 wherein the socket is made of a metal selected from the group consisting of mild steel, stainless steel or brass.

6. A means according to claim 1 wherein the conical member is made of a polymeric material.

7. A means according to claim 6 wherein the polymeric material is selected from the group consisting of nylon 66 or poly(ethylene terephthalate).

8. In combination with a rope of the type constructed of a core of parallel synthetic filaments encased in a sheath of thermoplastic material, an end fitting comprising a metal socket member having a socket cavity, said socket cavity having an inner tapered portion and an outer portion continuous with the smaller end of the tapered portion and closely surrounding the sheath material of an end portion of the rope, a conical member of polymeric material fitting within the tapered socket portion to provide a space between the latter and the surface of the conical member of substantially constant annular area equal to the total cross-sectional area of the fibers in the rope end, the filaments of the rope end protruding from the sheath and being distributed in said annular space and frictionally clamped between the conical member and the tapered socket portion, the included cone angle of the conical member being about 10 percent less than the natural angle of friction between the polymeric material of the conical member and the fibers.

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