SYNTHETIC ROPE STRUCTURE

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This invention relates to a synthetic rope structure and to a structure of strands for such a rope.

Synthetic rope, particularly that constructed of polyethylene, polypropylene and mixtures of filaments of these are superior in many respects to natural fibers, such as manila. However, rope fabricated from polyethylene filaments is too slippery (has too low a coefficient of friction) for certain usages. One application is in the hawser of a ship. A rope fabricated of polyethylene or polypropylene filaments slips irregularly on the capstan so that it is not possible to pay-out the rope steadily against the pull of a ship. In contrast, manila rope produces large frictional forces on the capstan and pays-out uniformly. The use of plastic rope for ship hawser has resulted in accidents because of too low friction and smoothness resulting in the rope paying out in jerks.

This invention is concerned with a rope structure which overcomes the foregoing difficulties and provides substantially greater coefficient of friction in conventional uses.

Accordingly, an object of the invention is to provide a rope of improved structure for uses in applications in which coefficient of friction is a factor. A further object is to provide a rope strand structure using polyethylene filaments which provides inherent roughness and increased coefficient of friction. Other objects of the invention will become apparent upon consideration of the accompanying description.

A broad aspect of the invention comprises a strand for a synthetic fiber rope comprising a core of unfomed synthetic filaments and an enclosing layer of foamed polymeric filaments of polyethylene, polypropylene, or mixtures of these polymers. Another broad aspect of the invention comprises a rope formed of foamed and unfomed synthetic filaments, the major portion of the outer filaments of the rope being formed of foamed polymer of polyethylene, polypropylene, or mixtures thereof. Foamed polyolefin filaments or fibers have a great deal more surface friction than the conventional unfoamed filaments or fibers. The foamed filaments of the copending application of Anthony Bottomley, S.J., 283,950, filed May 21, 1963, now U.S. Patent No. 3,214,234 are suitable for use in the foamed filaments of polyethylene and polypropylene are formed by incorporating any suitable foaming agent in the polymer before extrusion thereof into filaments. The amount of foaming agent used is in the range of 0.01 to 20 weight percent of the polymer, and preferably, in the range of 0.1 to 5 weight percent.

The broad class of foaming agents disclosed in said copending application are operable in the process of forming the filaments. It is preferred to utilize solid materials such as Expandex 177 (1,1′-azobisobutiramide), p,p′-oxybis(benzeneisulfonyl hydrazide) which is sold under the trade name of "Celogen" by Naugatuck Chemical, a division of the United States Rubber Company; diazoaminobenzene, dinitrosopentamethylenetetramine, 4-nitrobenzene sulfonic acid hydrazide, beta-naphthalene sulfonic acid hydrazide, diphenyl-4,4′-di(sulfonyl azide), and mixtures of materials such as sodium bicarbonate with a solid acid such as tartaric acid. However, gaseous and liquid foaming agents may be utilized less advantageously.

A more complete understanding may be had by reference to the accompanying schematic drawing of which FIGURE 1 is a side elevation of a rope constructed in accordance with the invention. FIGURE 2 is an enlarged transverse sectional view of the rope of FIGURE 1 taken on the line 2—2; and FIGURE 3 is a cross section of one type of structure for the individual strands 18 and 20.

Referring to FIGURES 1 and 2, rope 10 is formed of individual ropes 12, 14, and 16. Core strands 18 in each rope 12, 14, and 16 are preferably formed of unfomed polymer for strength and outer strands 20 are formed of foamed polymer to impart greater friction to the exterior of the rope. It is also feasible to utilize other synthetic filaments such as nylon and polyester fibers which have suitable strength. The drawing and orienting of the polymer filaments in conventional manner greatly increases the strength thereof.

Referring to FIGURE 3, a rope strand 22 is formed of 3 twisted individual strands 24, 26, and 28, each formed of a substantial number of individual filaments. If rope strand 22 is to be utilized as strands 18, all of the individual filaments are preferably formed of unfoamed polyolefin or other synthetic fiber which has been oriented to increase the strength thereof. In the event rope strand 22 is to be utilized in the exterior layer of the rope as rope strand 20, at least the outer layer of filaments of each of strands 24, 26, and 28 are formed of foamed polyolefin. In some applications it is desirable to form all of the filaments in individual strands 24, 26, and 28 of foamed filaments. At least the major portion of the filaments in the outermost area or layer of the rope must be formed of foamed filaments in order to impart a satisfactory amount of friction to the rope to improve its characteristics in this respect. In FIGURE 2, outer strands 20 are formed of inner filaments 21 of unfoamed polyolefin or other strong resin and outer filaments 19 of foamed polyolefin such as polyethylene and/or polypropylene.

It is not essential to utilize homopolymers of ethylene and propylene in the manufacture of the rope filaments or fibers. These olefins may be copolymerized with minor amounts of other C4 to C8 olefins and with each other to produce polymers of suitable strength and other characteristics for use as the rope filaments.

Certain modifications of the invention will become apparent to those skilled in the art and the illustrative details disclosed are not to be construed as imposing unnecessary limitations on the invention.

1. A strand for a polyolefin rope comprising a core of unfoamed polyolefin filaments and an enclosing layer of foamed polyolefin filaments, said polyolefin being selected from the group consisting of polyethylene and polypropylene.

2. The strand of claim 1 wherein said filaments consist essentially of polyethylene.

3. The strand of claim 1 wherein said filaments consist essentially of polypropylene.

4. The strand of claim 1 wherein one of said core and layer consists essentially of polyethylene and the other consists essentially of polypropylene.

5. A strand for a synthetic fiber rope comprising a core of unfoamed synthetic filaments and an enclosing
layer of foamed polymer filaments selected from the
group consisting of polyethylene, polypropylene, and
mixtures of these filaments.

6. A rope comprising a core formed of a plurality of
strands of unfoamed synthetic filaments encased in a
layer of strands having the structure of claim 1.

7. A rope comprising a core formed of a plurality of
strands of unfoamed synthetic filaments encased in a
layer of strands having the structure of claim 5.

8. A rope formed of foamed and unfoamed synthetic
filaments, the major portion of the outer filaments of said
rope being formed of foamed polymer selected from the
group consisting of polyethylene, polypropylene, and mix-
tures thereof.