United States Patent [19]

Rhodes et al.

[11] **3,844,195**

[45] **Oct. 29, 1974**

[54] **PRODUCTS**

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[52] **U.S. Cl.** ..... **87/1,** 57/140 BY, 57/153, 87/8, 161/89, 161/92, 308/238, 308/DIG. 8

[51] **Int. Cl.** **F16j 15/22,** D02g 3/04, D04c 1/06

[58] **Field of Search**.. 28/DIG. 75 R; 161/70, 88–98; 87/1, 8; 57/140 BY, 153; 308/163, 238, DIG. 7, DIG. 8

[56] **References Cited**

UNITED STATES PATENTS

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Primary Examiner—John Petrakes

[57] **ABSTRACT**

A yarn comprised of 50–80 percent filaments of polytetrafluoroethylene and 50–20 percent of an aromatic polyamide. The yarn is used to make braided packing for sealing pumps and the like to prevent or reduce leakage.

4 Claims, No Drawings

PRODUCTS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to improved yarns for use in packings which are used to prevent or reduce leakage around rotating pump shafts. More particularly the invention is directed to a yarn containing polytetrafluoroethylene filaments and aromatic polyamide filaments.

2. Description of the Prior Art

Polytetrafluoroethylene has found use in packing materials for sealing pumps and the like to prevent leakage. For example, U.S. Pat. No. 3,306,155 discloses packing materials in which polytetrafluoroethylene is employed in two ways. Firstly, it is used to impregnate glass fibers which are made into braided packing material. Secondly, it is used in filament form as a sheath of filaments surrounding a core of glass filaments. Both the sheath and the core can be impregnated with tetrafluoro-ethylene.

Polytetrafluoroethylene has been used in packing materials because of its ability to withstand high temperature, and its inertness (i.e., its resistance to attack by solvents or corrosive chemicals). However, at high shaft speeds, or with old slightly defective pumps, or where shaft run-out (wobble) is substantial, packings of polytetrafluoroethylene have been found to leak excessively. The yarn of the present invention can be employed in braided packing to overcome this problem.

SUMMARY OF THE INVENTION

The yarn of this invention comprises a plied yarn consisting essentially of between about 50–80 percent by weight of polytetrafluoroethylene filaments and between about 50–20 percent by weight of aromatic polyamide filaments, based on the total weight of both types of filaments. Preferably, the yarn is coated with fine particles of polytetrafluoroethylene. It is also sometimes desirable that the yarn be coated with an inert lubricating fluid such as a silicone oil.

This invention also is directed to a braided packing material comprising the yarn of this invention.

DESCRIPTION OF THE INVENTION

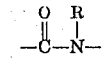
The Polytetrafluoroethylene Filaments

The polytetrafluoroethylene (PTFE) filaments are preferably in the form of continuous filaments in a multifilament yarn. The PTFE filaments may be prepared by methods which are well known in the art. A suitable procedure is described by Burroughs and Jordan in U.S. Pat. No. 2,772,444. For use in packings it is desirable that the PTFE filaments be bleached to remove any residual organic material. This may be done as described by Burroughs et al. in the above-mentioned patent or by heating the yarn in an oven at 315° C. for 48 hours.

The Aromatic Polyamide Filaments

Fibers of aromatic polyamides, such as poly(metaphenylene isophthalamide), possess very desirable physical and chemical properties, such as high temperature resistance, chemical stability and flame resistance. These fibers have been tested in packings but have a relatively short life when used under conditions of high shaft speed and/or high shaft run-out.

The term aromatic polyamide as used herein refers to a polymer wherein repeating units are linked by an amide group, i.e., the



radical wherein R is hydrogen or lower alkyl; the nitrogen and carbon atom of each repeating amide radical being directly attached to the carbon atom in the ring of an aromatic radical, that is, the nitrogen and carbon atom of each repeating amide group each replaces a hydrogen of an aromatic ring. The term aromatic ring means a carbocyclic ring possessing resonance. Suitable polymers are disclosed in U.S. Pat. No. 3,094,511 and British Pat. No. 1,106,190. The preferred aromatic polyamide is poly(meta-phenylene isophthalamide).

Filaments may be spun from the above aromatic polyamides following procedures outlined in German OLS Pat. No. 2,044,281. Preferably, an additional final step of heating the filaments to increase its crystallinity is employed.

The Yarn of this Invention

The PTFE filaments may be combined with the aromatic polyamide filaments by plying the respective filaments, preferably without twist. If desired, the yarns of the filaments may be interlaced as described by Bunting and Nelson in U.S. Pat. No. 3,110,151.

It has been found surprisingly that the addition of 50 to 80 percent of polytetrafluoroethylene filaments to the aromatic polyamide filaments results in a packing material with a much longer wear life. Preferably the proportion of polytetrafluoroethylene filaments present is in the range of 65–75 percent by weight.

It has been found desirable that the yarns of this invention be coated with finely divided polytetrafluoroethylene particles. This is accomplished by passing the yarn through an aqueous dispersion containing the particles. Aqueous dispersions of the type described in U.S. Pat. No. 2,772,444 or U.S. Pat. No. 3,391,099 may be employed for this purpose. Preferably, about 50 to 100 percent, based on the weight of fiber, is deposited on the yarn. The presence of the PTFE particles on the yarn leads to packings which are more impervious to fluids and leakage is thus reduced.

The yarns of this invention are also preferably coated with 20 to 50 percent, based on fiber weight of an inert lubricating fluid such as a polyorganosiloxane (silicone fluid) of the type described in Canadian Pat. No. 536,465. The silicone fluid selected should preferably have a viscosity of 800–1,200 centistokes at 25° C. and should remain fluid, i.e., should not harden when in contact with the fiber surface. The preferred silicone fluids are polyalkylsiloxanes such as polymethylsiloxane. The application of a fluid of this type to the yarn results in packings which are softer and more readily conformable to the packing space available.

EXAMPLE 1

Four ends of 1,525 denier, 180 filament bleached polytetrafluoroethylene yarn are combined with two ends of poly(metaphenylene isophthalamide) yarn of 1,200 denier and 600 filaments by withdrawing the individual yarns from packages held on a magazine-type creel and combining the six yarns at a power-driven feed roll. The combined yarn contains 72 percent by

weight of polytetrafluoroethylene fiber. From the feed roll the yarn is led through an aqueous dispersion of finely divided polytetrafluoroethylene particles where 61.7 percent, based on the weight of fiber, of polytetrafluoroethylene particles is deposited on the yarn. The dispersion contains 65 percent by weight of PTFE particles having an average particle diameter of about 0.2 micron and 5 percent of triton X–100, a nonionic octylphenoxyethanol surfactant, as a stabilizer. The yarn is then dried and thereafter passed through a container of polymethylsiloxane having a viscosity at 25° C. of 1,000 centistokes to provide 29.8 percent of the fluid based on the weight of fiber. The yarn is then processed into a ⅜ inch square braided packing on a conventional braiding machine using a lattice braid. After braiding the packing is calendered to size in the conventional manner.

Some of the packing thus produced is used to seal the shaft of a pump used to pump pigment dispersions. The pump has a shaft diameter of 3-¾ inch, a speed of 400 rpm and the shaft run-out was observed to be relatively great. The packing failed after 33 days' service. A packing prepared in a similar fashion using 100 percent poly(meta-phenylene isophthalamide) yarn failed after 6 days' service.

EXAMPLE 2

Following the general procedure of Example 1, braided packings are prepared with various combinations of polytetrafluoroethylene yarn and poly(metaphenylene isophthalamide) yarn and with 100 percent polytetrafluoroethylene yarn. The combined yarns are treated with a dispersion of polytetrafluoroethylene particles and with polymethylsiloxane just as in Example 1. These packings are used to seal the shafts of an eight-position packing test apparatus. The test apparatus consists of four horizontally mounted cylinders with stuffing boxes at either end. Shafts of 2 inch diameter are mounted axially in the cylinders. Each shaft extends through the stuffing boxes at either end and are sealed by the braided packings which is packed in the stuffing boxes. Water under 25 psig pressure is supplied to each cylinder between the stuffing boxes and leakage of water between the shaft and the packing is observed at either end.

In packing the stuffing boxes it is found that a substantially higher pressure must be applied to the 100 percent polytetrafluoroethylene packing material to obtain a good seal initially than is the case with the packing prepared as in Example I. This is also the case with the packing containing 85.7 percent polytetrafluoroethylene.

The shafts are belt driven, two (four positions) at 1,800 rpm and two at 3,600 rpm. At both speeds the shafts, which are under no load, run smoothly with little run-out. At 1,800 rpm all of the packings perform satisfactorily. At 3,600 rpm the packings prepared from 100 percent polytetrafluoroethylene yarn leak excessively around three of the shafts. With a packing prepared as in Example 1 performance is satisfactory on all the positions. However, packings containing 85.7 and 39 percent polytetrafluoroethylene fiber, based on the total weight of fiber in the packing, do not perform satisfactorily.

The preceding representative examples may be varied within the scope of the present total specification disclosure, as understood and practiced by one skilled in the art, to achieve essentially the same results.

The foregoing detailed description has been given for clearness of understanding only and no unnecessary limitations are to be understood therefrom. The invention is not limited to the exact details shown and described for obvious modifications will occur to those skilled in the art.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A yarn consisting essentially of between about 65–75 percent by weight of polytetrafluoroethylene filaments and between about 35–25 percent by weight of aromatic polyamide filaments, based on the total weight of said filaments, said yarn containing a coating of finely divided polytetrafluoroethylene particles and additionally containing an outer coating of a polyorganosiloxane.

2. The yarn of claim **1** wherein the aromatic polyamide is poly(meta-phenylene isophthalamide).

3. A packing material comprising a braided structure containing the yarn of claim **1.**

4. The braided structure of claim **3** wherein the aromatic polyamide is poly(meta-phenylene isophthalamide).

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