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LINT-FREE MEDICAL APPLICATOR

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Fig. 1.

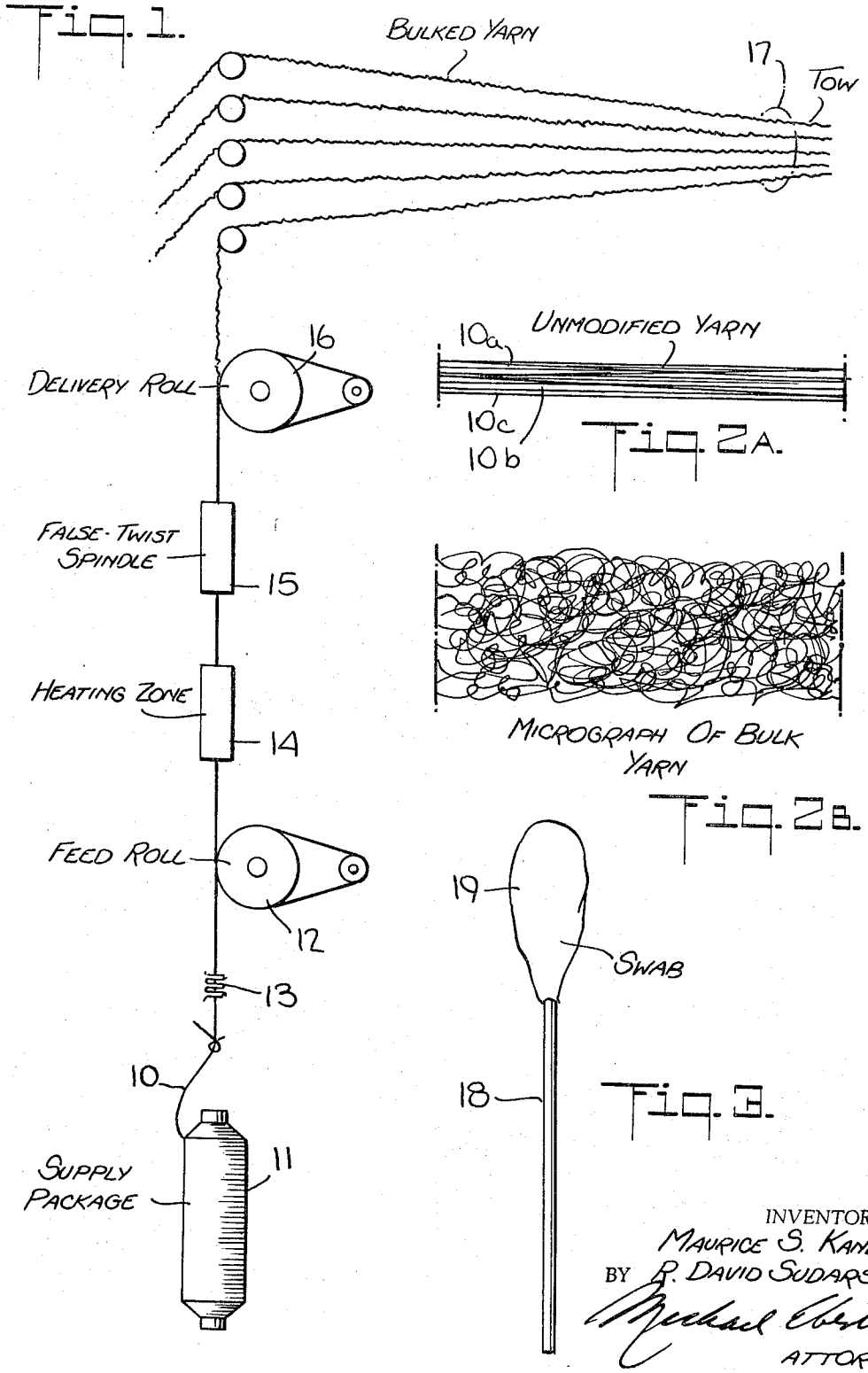

Fig. 2A.

MICROGRAPH OF BULK YARN

Fig. 2B.

Fig. 3.

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LINT-FREE MEDICAL APPLICATOR

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This invention relates generally to absorbent medical pads, sponges, tampons, dressings and the like, and more particularly to a lint-free swab formed of texturized synthetic material.

Swabs are widely used as medical applicators and for various delicate cleaning operations. Conventional swabs are fabricated from a small mass of natural fibers, such as cotton, wool or gauze, and are commonly used in medical practice for mopping up blood during an operation or discharges, or for applying antiseptics to the body.

While swabs made of such fibrous materials as cotton are highly absorbent, even though the material is sterile, it may nevertheless be unsuitable for certain uses. Thus in surgical situations and in other cases requiring the total absence of foreign matter, the usual swab is not acceptable because of lint. Short lengths of the material and minute particles of lint are present even in the most carefully prepared swab, and the dustlike particles tend to precipitate onto the surface being swabbed. Thus when an incision is made and then swabbed, lint may be left behind in the incision and sealed therein after the incision is sutured. This foreign matter may interfere with the healing process and give rise to medical difficulties.

Accordingly, it is the primary object of the present invention to provide a swab or other absorbent medical applicator formed of a highly adsorbent, lint-free material. Though the invention will be described mainly in connection with the fabrication of a swab, it is to be understood that the same materials and methods are equally applicable to the making of medical sponges, tampons, bandages, dressings and a wide variety of absorbent bodies required in medical and surgical situations in which freedom from lint is a vital desideratum.

More specifically, it is an object of the invention to provide a swab formed of long texturized synthetic continuous filaments rather than short fibers of natural material. While such synthetic filaments, when unmodified, ordinarily have low adsorption characteristics, they are rendered highly adsorbent by a false-twist or other texturizing technique.

A significant feature of the invention resides in the fact that the absorbent material is radiologically opaque, hence in the event the sponge, swab or pad is inadvertently left within the patient's body during surgery, its presence and location can be determined by X-ray techniques.

Also an object of the invention is to provide a sterile, highly adsorbent medical applicator or sponge which may be manufactured and sold at relatively low cost, and which is particularly useful as an applicator or for cleansing purposes in those situations, as in eye operations, where even the most minute residue from the swab is highly deleterious.

Briefly stated, these objects are accomplished by texturizing individual multi-filament yarns of synthetic material to form a bulked yarn, a plurality of bulked yarns being clustered to form a tow which is wound about an applicator stick to form a swab of high quality. The resultant swab is not composed of short fibers of natural material but of a plurality of continuous filaments each one of which is relatively long and cannot separate from the mass of the swab. Basically the same technique can be used to form dressings, tampons and a variety of other medical applicators or sponges.

For a better understanding of the invention, as well as other objects and further features thereof, reference is made to the following detailed description to be read in conjunction with the accompanying drawing, wherein:

FIG. 1 shows schematically a system for producing a tow of adsorbent yarns in accordance with the invention;

FIG. 2A is an enlarged view of unmodified yarn;

FIG. 2B is a micrograph of one false-twisted yarn made by the system; and

FIG. 3 is a swab made from the tow material.

The present invention makes use of synthetic materials such as polyamide, vinyl, polyester or acrylic yarns, formed of fine continuous filaments. The adsorption characteristics of continuous filament yarns is relatively low as compared to yarns of natural materials, such as cotton or wool. Adsorption is a process by which the surface of a solid (the adsorbent) attracts and holds any atom or molecule (the adsorbate) from a solution with which it is in contact. The total amount of liquid adsorbed depends on the hydrophilic affinity between the adsorbent and the adsorbate, and the total surface exposed to the mobile particles. Finely divided yarn materials have high adsorbent capacities because of the enormous amount of exposed surface area relative to their mass.

Continuous-filament yarns have a low adsorption characteristic but can be rendered highly adsorbent by a process known as texturizing or bulking. Bulked or textured yarns are those which have been treated so as to have greater apparent bulk or volume than their yarn numbers indicate they should. The texturizing process acts to introduce crimps, coils, loops or crinkles into otherwise smooth, continuous filaments, and in the case of nylon or other thermoplastic materials, it exploits the thermoplasticity of the material and its ability to be deformed, heatset and developed.

While the present invention is not limited to nylon, we shall for purposes of describing the technique, make use of this material as an example of how the invention is carried out. Essentially, the invention takes individual yarns of nylon composed of a multiplicity of fine, smooth and continuous filaments and texturizes the yarn to form a bulked yarn in which the individual filaments thereof are crimped or otherwise bulked.

A large number of such bulked yarns is then brought together into a tow, and because of their bulked characteristics, the several yarns intertangle to form a fluffy and highly adsorbent matting. In accordance with well-known swab-making techniques, the tow is then twisted about a stick to form individual adsorbent tips. Alternatively, the tow may be wound about a removable mandrel to form a ball, which ball serves as a swab or sponge. The resultant ball or pad may be incorporated within a woven or knitted sheath which is shaped to provide a dressing having a desired configuration.

Preferably, the texturizing of the continuous-filament nylon yarn is carried out by the so-called false-twist process which sequentially carries out twisting, heat-setting and untwisting, thereby providing a continuous operation. The yarn **10**, as shown in FIG. 1, is a multi-filament nylon taken from a yarn package **11** and is fed by feed rolls **12** at a controlled tension which is determined by a suitable tensioner **13**, through a heating zone **14**. From the heating zone, the heat-softened yarn passes into a false-twist spindle **15**, the yarn being drawn therefrom by a delivery roll **16**. The twist between the false-twist spindle and the feed rolls is set into the yarn by heating and cooling before it passes through the false-twist spindle.

The principle of operation is as follows: If a stationary multi-filament yarn is held at both ends and twisted in the center by a hollow false-twist spindle, then equal amounts of twist with opposing directions of spirality will

be imparted on each side of the spindle. While each half of the yarn, if considered separately, appears to have a real twist therein, the algebraic sum of twist of the yarn through the length thereof as a whole is zero. With the false-twist spindle rotating continuously but with the yarn passing forward, the system reaches a state of equilibrium wherein no twist exists after the yarn has passed through the tube. This happens because of the cancelling out of the twist on the delivery side of the tube.

Thus when equilibrium is reached, there are constantly twisted filaments on the intake side of the rotating spindle, and untwisted filaments on the output side thereof. Since the heater is on the input side of the spindle, with enough space left for cooling between the twisted yarn passing through the rotating spindle, the three basic steps of twisting, heat-setting and untwisting are carried out simultaneously.

In FIG. 2A there is shown in enlarged view an unmodified multi-filament yarn formed of continuous nylon filaments **10***a*, **10***b*, **10***c*, etc., such as 70-denier, 34-filament yarn. When this yarn is false-twisted, the resultant structure, as shown in the micrograph in FIG. 2, is composed of individual filaments which are looped, curled, twisted, tangled or otherwise distorted to form a bulked yarn of relatively high volume. False-twist yarns of this type have very high water intake as compared to continuous-filament yarns not so textured.

Thus continuous-filament yarns having a denier of 2 per filament have a water adsorption of 355%, whereas the same yarn when false-twisted has a water adsorption of 1,651%. Edge-crimped yarn, on the other hand, of 2 denier per filament, has a water adsorption of 906%, while air-texturized yarn has a water adsorption of 558%. It is to be noted, therefore, that the false-twist technique produces a higher percentage of adsorption than other texturizing methods.

The bulked yarns from a battery of identical false-twist systems are brought together in a tow **17** and because of the looped and curled nature of the yarns, the yarns intertangle and interlock to form a matted mass whose appearance is similar to commercially produced adsorbent cotton. This tow is then wound about a stick **18** to form an adsorbent tip **19**.

In practice, if the tow is composed of ten 34-filament bulked yarns, the tow then is made up of 340 fine continuous filaments. After the tow is wound without tension about a stick or removable mandrel to the desired swab or ball size, it is then cut, and because of the interlocking nature of the filaments, the swab or ball will hold together without unwinding. Because each of the 340 filaments in the swab is in a continuous length running several feet, it cannot be separated from the other filaments and no lint exists.

Thus the advantage of the swab or other medical applicator made from texturized filaments of nylon or other synthetic material is the total absence of lint and other particles, coupled with the exceptionally high adsorbency of the tip. This makes it possible to use the swab in many delicate medical and surgical procedures in which conventional swabs are not acceptable. It will also be appreciated that it is possible to wind the tow into relatively large balls to provide lint-free sponges for large incisions and operations.

The nylon or other synthetic material used to form an applicator in accordance with the invention is preferably of the type which includes titanium-oxide pigment or other radiologically opaque substances, whereby should the applicator be accidentally left behind in the patient's body, its rapid detection is made possible by X-ray techniques. In practice, the pigment is incorporated in the polymer melt prior to spinning, whereby the titanium oxide or other material is dispersed throughout the continuous filaments.

While there has been shown a preferred embodiment of lint-free swab in accordance with the invention, it will be appreciated that many changes may be made therein without departing from the essential spirit of the invention as defined in the annexed claims.

What we claim is:

1. A lint-free medical device comprising a tow of texturized continuous multifilament synthetic yarns wound into a mass having highly adsorbent properties, the yarns forming said tow being individually false-twisted, the false-twisted yarns being intertangled in said tow.

2. A device, as set forth in claim **1**, wherein said yarns incorporate a radiologically opaque pigmentary material.

3. A lint-free swab comprising a stick and a mass of adsorbent material attached to one end of said stick, said material being constituted by a tow of yarns each formed of continuous synthetic filaments, each yarn being individually false-twisted to enhance its adsorption properties, the false-twisted yarns being intertangled in said tow, said tow being wound about said stick.

4. A swab as set forth in claim **3**, wherein said filaments are constituted by false-twisted nylon.

5. A swab as set forth in claim **3**, wherein said filaments are constituted by texturized polyamide filaments.

6. A swab as set forth in claim **3**, wherein said filaments are constituted by texturized polyvinyl filaments.

7. The method of forming a lint-free medical device, comprising continuously texturizing a plurality of continuous multifilament synthetic yarns to form bulked yarns, said yarns being individually false-twisted, collecting said bulked yarns into a tow in intertangled relationship to produce a matted mass, and winding said tow into a mass.

8. The method, as set forth in claim **7**, wherein said tow is wound about a stick.

9. The method, as set forth in claim **7**, wherein said tow is wound about a removable mandrel to form a ball.

10. The method, as set forth in claim **7**, wherein said tow is wound into a mass which is ensheathed within a fabric envelope to provide a shaped dressing.

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