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[54] **METHOD OF ATTACHING WITHDRAWAL STRING TO A SPONGE TAMPON**
5 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **156/73,** 156/73, 128/270, 156/380
[51] **Int. Cl.** **B29c 27/08,** A61f 13/20
[50] **Field of Search** 156/73; 128/270, 285

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ABSTRACT: A method for economically and efficiently securing a withdrawal string to a regenerated cellulose sponge tampon in the manufacture of menstrual tampons. A string which includes a heat-reactive adhesive element is inserted into a sponge tampon, and sonic energy is then applied to the tampon to provide a rapid and highly localized heating of the adhesive element, causing it to flow into intimate contact with the surrounding sponge material and form a secure bond between the string and sponge when cooled. The disclosure alternatively shows a means for simultaneously applying an adhesive substance to a string as it is being drawn into a sponge tampon so that an adhesive coating is applied only to the portion of the string contained within the tampon.

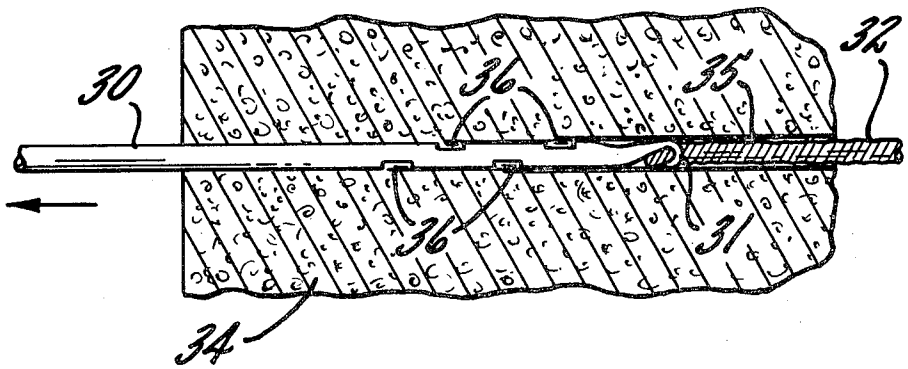
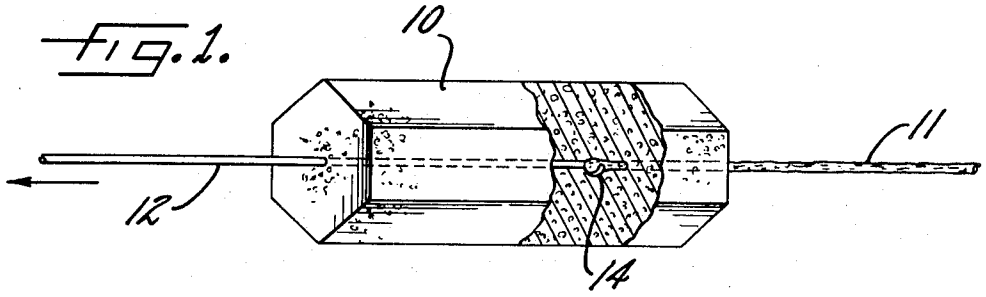


Fig. 1.



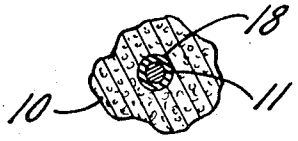


Fig. 2.

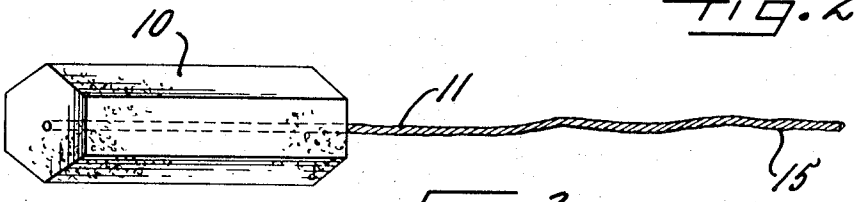


Fig. 3.

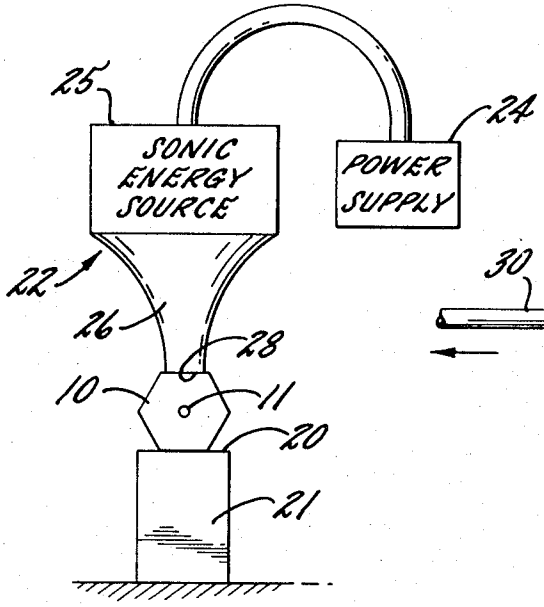


Fig. 4.

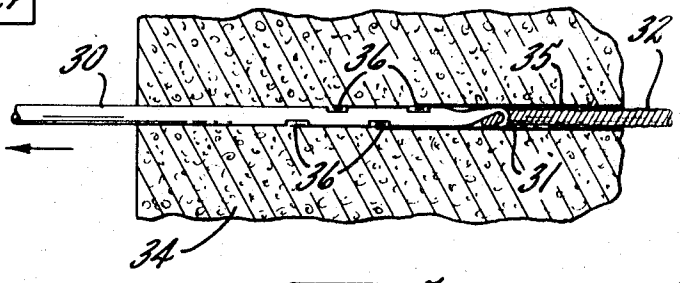


Fig. 5.

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METHOD OF ATTACHING WITHDRAWAL STRING TO A SPONGE TAMPON

DESCRIPTION OF THE INVENTION

The present invention relates generally to absorbent menstrual tampons and the like, and more particularly to an improved method of making such tampons.

Some prior menstrual tampons have been made of fibrous material, and the withdrawal string has been sewn to the tampon. With tampons made of sponge, however, sewing the withdrawal string to the tampon decreases the efficiency of the sponge. Heretofore, various methods have been proposed for attaching the withdrawal string to sponge tampons without sewing, such as by using glues or heat sealable thermoplastics. These prior methods, however, often have been ineffective in reliably securing the withdrawal string have required heating of the entire sponge to the fusion temperature of the heat sealable thermoplastic often charring or damaging the sponge, or have required equipment that is relatively expensive or inefficient.

Accordingly, it is an object of the present invention to provide an improved method for economically and efficiently securing a withdrawal string to a sponge tampon in the manufacture of menstrual tampons.

Another object is to provide a method for reliably bonding a withdrawal string to a sponge tampon by means of a heat-reactive substance wherein there is less tendency of charring or decomposing the sponge during the heating process. More particularly, an object is to provide such a method which utilizes an energy source adapted to create a highly localized heating of the adhesive without heating the entire sponge tampon to the fusion temperature of the adhesive.

A further object is to provide a method of the foregoing type which more efficiently utilizes energy in the heating process and requires equipment that is relatively inexpensive.

Still another object is to provide a method for adhesively bonding a withdrawal string to a sponge tampon without contaminating or coating the outwardly extending handle portion of the string with the adhesive. In this connection, it is an object to provide a method and means for simultaneously applying an adhesive substance to the string as the string is being inserted into the sponge tampon.

Other objects and advantages of the invention will become apparent from the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective and partial sectional view of an uncompressed sponge tampon with a string having an adhesive coating being inserted longitudinally through the tampon by an appropriate needle;

FIG. 2 is an enlarged fragmentary cross section of the string and tampon shown in FIG. 1.

FIG. 3 is a perspective of the tampon shown in FIG. 1 with the string fully positioned in the tampon;

FIG. 4 is a schematic side elevation of an apparatus for applying heat to the string and tampon assembly shown in FIG. 3 in bonding the string to the tampon; and

FIG. 5 is a section view of an alternative means for inserting a string into a sponge tampon, which simultaneously applies an adhesive substance to the string as it is drawn into the tampon.

While the invention is susceptible of various modifications and alternative forms, certain specific embodiments thereof have been shown by way of example in the drawings which will be described in detail herein. It should be understood, however, that it is not intended to limit the invention to the particular forms disclosed but, on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention.

Turning to the drawings, FIG. 1 shows an elongated sponge tampon **10** preferably formed of dry, fine-pore, expanded, regenerated cellulose material and shaped to a typical tampon length. While the illustrated tampon **10** has a cylindrical form with a polygon cross section, it will be understood that various other well-known shapes may be employed. As will be explained below, the tampon **10**, which is shown in its uncompressed fully expanded state, subsequently may be radially and longitudinally compressed in forming the desired finished shape and be of a size adapted for easy insertion into the vaginal tract.

A withdrawal string **11** is shown in FIG. 1 being inserted into the tampon **10** by passing a needle **12** longitudinally through the tampon. The needle **12** has a barbed end **14** to which one end of the string **11** is attached. By passing the needle completely through the tampon and unhooking the string, the string remains coaxially positioned along the entire length of the cylindrical tampon. The string may then be cut, or may be precut to the required length, so that a portion **15** remains extending outwardly from the tampon to serve as a withdrawal string handle. The string at this point, however, is not bonded to the tampon.

To facilitate subsequent bonding of the string **11** to the tampon **10** in the illustrated method, the string, or at least the portion of the string which is to be inserted into the tampon **10**, includes a heat-reactive bonding element **18**. The bonding element **18** may be a thermoplastic adhesive which is previously applied to the string by dipping the string into the adhesive, or by other well-known applicator means. When the adhesive is cooled to room temperature, it solidifies and forms the uniform coating **18** surrounding, or impregnating and surrounding, the string as shown in FIG. **2**. The thermoplastic adhesive should have a sufficiently high melting point that it is not melted or sticky at body temperature or slightly above, and is not soluble in menstrual fluid. Thus, the entire string may be coated with the adhesive if desired.

A typical mercerized cotton string impregnated and coated with a thermoplastic adhesive such as a composition of 50 percent Elvax 40 - 50 percent Elvax 150 (Elvax is a copolymer of ethylene and vinyl acetate) has been found to form a highly satisfactory string for use in the process of the present invention, although other suitable thermoplastic adhesives may be used. Other nonfusible yarns or strings made of linen, hemp, regenerated cellulose, rayon or the like, can be combined with thermoplastic adhesives. Synthetic yarns of material with a melting point lower than the adhesive may also be used. While the thermoplastic adhesive coatings should not fuse or lose bonding strength at human body or commercial storage temperatures, it will be appreciated that they should be readily fusible at higher temperatures to which the regenerated cellulose sponge tampon can be heated without decomposing the sponge. It should be noted that the string is the force carrier, i.e., the string should be strong enough after processing to be able to withdraw the tampon without breaking, and the thermoplastic coating is the adhesive agent that does the bonding. The string properties must be of such composition that it fulfills its force carrier relationship with the ultrasonic process, i.e., there exists a differential temperature between the string and the adhesive such that the string will not melt, char, decompose or lose strength during the string coating or ultrasonic attachment process. In addition, the thermoplastic coating provides a protective coating that prevents exudate from soaking through it during use.

In accordance with the invention, a sonic energy source is provided for rapidly, efficiently, and economically heating the heat-reactive bonding element surrounding the portion of the string inserted within the sponge tampon. Sonic energy is directed into the sponge tampon to create a nearly instantaneous and highly localized heating of the adhesive coating causing it to become fluid and flow into intimate contact with the adjacent fine pores of the regenerated cellulose sponge tampon. Subsequent cooling and solidifying of the adhesive creates a secure bond between the string and the sponge. In the illustrated embodiment, the tampon **10** with the inserted adhesively coated string **11** is positioned on an upper surface **20** of an anvil **21** immediately below a sonic energy source, generally indicated at **22**. The energy source may be designed with a frequency which may vary from a few thousand cycles

per second up to perhaps one million cycles per second or more. However, to minimize the problem of audible noise and to provide an efficient source of energy, it is preferred to employ an ultrasonic energy source that is capable of providing at least 20,000 cycles per second. Typically, the energy source **22** may be of a conventional type, including a power supply **24** capable of providing necessary electrical energy and a converter **25** for converting the electrical energy into mechanical energy in the form of vibrations. The converter **25** may be a piezoelectric element made of material such as barium titanate or lead zirconium titanate.

A horn **26** is employed to transmit the mechanical vibrations from the converter **25** to the sponge tampon **10**. The horn **26** may have various masses and shapes depending upon the output oscillations desired and the configuration of the tampons being heated. To facilitate uniform heating of the string, the horn may have a narrow elongated end surface, such as the surface **28**, which can be placed on the tampon directly over a substantial portion of the string contained within the tampon. The horn **26** is adapted to be brought into position so that its end **28** bears firmly against the tampon **10** with a prelocated pressure preferably of between 20 to 40 lbs. The energy source **22** thus provides, within the region of the horn, an intense highly localized zone of sonic energy.

During a controlled period of time that the horn is in contact with the tampon, high frequency mechanical vibrations are transmitted from the horn into the sponge tampon. The vibrations travel through the sponge until they reach the juncture of the string and sponge surfaces. The intense vibration of one surface moving against the other at high frequencies creates a sufficient buildup of heat through friction to cause the adhesive surrounding the string to melt and readily flow into the adjacent sponge pores. The temperature created by the sonic energy at the juncture of the string and sponge, which may be regulated by the time interval the horn is in contact with the tampon and by its frequency output, should be sufficient to melt and set the adhesive substance but not char or burn the cellulose sponge. Since the Generally, a temperature of less than 450° has been found to be satisfactory. Since the sonic energy creates highly localized heating at the string and sponge juncture, the entire sponge generally does not reach the fusion temperature of the adhesive so that there is less tendency of damaging the sponge during the heating process. After the adhesive is cooled, a secure bond is created between the string and sponge which will withstand the stresses of commercial storage conditions, immersion in menstrual fluid, and the force required to remove the wet, used tampon from a vagina.

It will be appreciated that the use of sonic energy in the method of the present invention has several advantages over prior methods. First, such energy is adapted to create rapid and highly localized heating which quickly activates the adhesive in setting the bond between the string and the sponge material. In addition, sonic energy may be utilized much more efficiently than other energy sources since a high percentage of the output energy from a sonic energy source is converted to heat generated vibrations in this application and the heat is concentrated at the location of the string without heating the entire sponge to the adhesive fusion temperature.

While in the illustrated embodiment the bonding element of the string was a thermoplastic adhesive coating, alternatively thermoplastic fibers could be combined with nonthermoplastic yarn in forming the string. Thermoplastic fibers, such as vinyon fibers, may be twisted in a strand and then wound around the nonthermoplastic yarn, such as rayon or cotton, in a "barberpole" fashion. Also the thermoplastic material can be interwoven with a nonthermoplastic material. The application of sonic energy to such a string inserted in a sponge tampon will thermally fuse or melt the thermoplastic fibers sufficiently that they will bond to both the regenerated cellulose sponge and the rayon or cotton yarn. The yarn will continue to provide tensile strength to the string.

Referring now to FIG. **5**, there is shown still another alternative way of applying a bondable adhesive to the withdrawal string. In the embodiment, an adhesive substance is applied to the string at the same time the string is being inserted into the sponge. To this end, there is shown a hollow needle **30** having a barbed end **31** drawing a nonfusable string **32**, preferably made of rayon or cotton yarn, through an expanded, regenerated cellulose sponge tampon **34**. As the string **32** is drawn into the sponge tampon **34**, a heat-reactive adhesive substance is directed by known means through the hollow needle **30** and is extruded out openings **36** in the side of the needle **30** to coat the surrounding area inside the sponge and the string **32** as it is advanced through the sponge. The adhesive substance may be thermoplastic adhesive material of the type described above which cools and solidifies after being inserted into the sponge to create at least a temporary bond between the string and the porous cellulose sponge. The subsequent application of sonic energy to the sponge tampon **34** in the above-described manner will again melt the adhesive **35** and cause a further flow of the substance into the surrounding sponge pores to insure bond between the string and the sponge when the adhesive finally solidifies.

As an alternative to extruding a thermoplastic adhesive in the embodiment of FIG. **5**, various solvent system adhesives may be used. In such case, the adhesive solution similarly is directed out of openings **36** in the needle and coats the string being drawn through he sponge and the surrounding area. When sonic energy subsequently is directed into the tampon sponge, the generated heat drives off the solvent and leaves an adhesive residue which sets and securely bonds the string to the adjacent sponge material.

It will be understood that after the withdrawal string has been bonded to the expanded, regenerated, cellulose sponge tampon, the sponge tampon may be radially compressed by known means up to 50 percent of its diameter to shape the tampon to a final desired configuration. The finished tampon may then be placed into an appropriate applicator tube or dispenser Thus, the expanded sponge tampon may initially have any desired elongated shape which facilitates its handling during the string insertion and heating manufacturing steps. It will also be appreciated if the final compressing of the expanded cellulose sponge tampon follows immediately after the heating step, the compressive force will aid in the formation of a strong permanent bond between the withdrawal string and the sponge when the adhesive is cooled to room temperature.

It will further be apparent to those skilled in the art that other variations from the examples given may be employed without departing from the spirit of the present invention. For example, instead of inserting a string into a cellulose sponge tampon by means of the needle, a tampon made of laminated layers of cellulose sponge could be used with the adhesively coated withdrawal string being interposed between the sponge layers. Moreover, while in the illustrated method a single string was inserted into a single tampon, alternatively, a plurality of parallel strings could be inserted into a single sponge layer and sonic energy could be applied to the entire layer to simultaneously bond all the strings to the sponge. The sponge layer could then be cut into individual tampons, each containing a single withdrawal string. While the process is particularly useful for use in the manufacture of cataminial devices it is readily adapted to string attachment to absorbent devices for other uses.

The following is claimed as invention:

1. A method of securing a withdrawal string to a tampon of dry, expanded, fine-pore, regenerated cellulose sponge in the manufacture of menstrual tampons, comprising the steps of inserting a string into said sponge tampon by drawing the string through the tampon with a hollow needle so that a portion of the string is contained within said tampon and a portion extends outwardly of the tampon, simultaneously supplying a heat-reactive adhesive substance to said string as it is being inserted into said tampon by passing said adhesive substance through the interior of said needle in a fluid state and extrud-

ing said adhesive substance into the tampon as the string is drawn by the needle, placing said tampon with said inserted string adjacent an ultrasonic energy source, and directing sonic energy into said tampon to heat said adhesive substance to a temperature sufficient to cause it to bond with the surrounding sponge while not decomposing the sponge tampon.

2. The method of claim wherein said adhesive is applied only to the portion of said string which is inserted into said tampon.

3. The method of claim 1 wherein said adhesive substance is a hot melt adhesive material.

4. The method of claim 1 wherein said adhesive substance is a fluid dispersion including a carrier solvent causing the remaining adhesive element to securely bond said string to the tampon.

5. The method of claim 1 wherein said sonic energy has at least 20,000 cycles per second.

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