Sept. 24, 1974 H. G. REIMELS 3,837,950

SURGICAL SPONGE

Original Filed Feb. 17, 1971

Fig. 1.

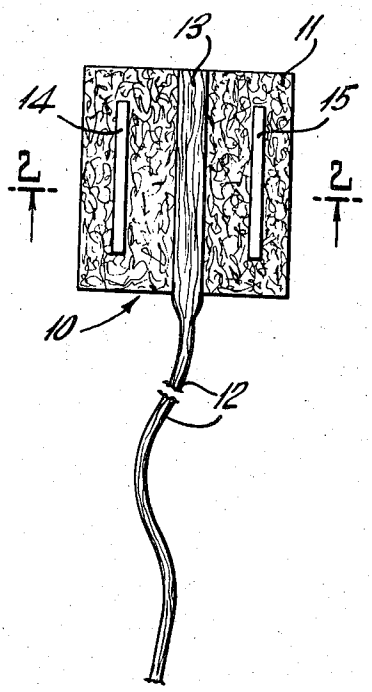
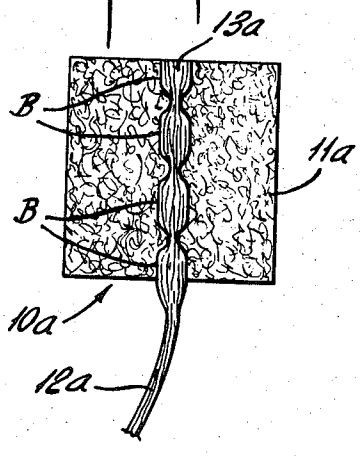


Fig. 2.



Fig. 5.



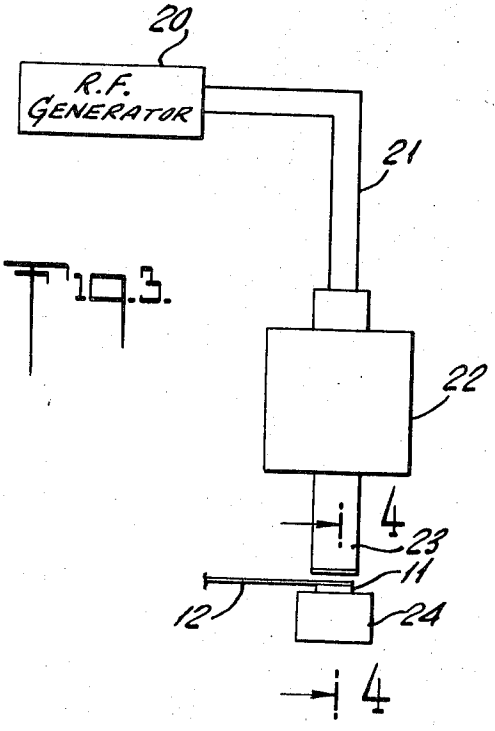
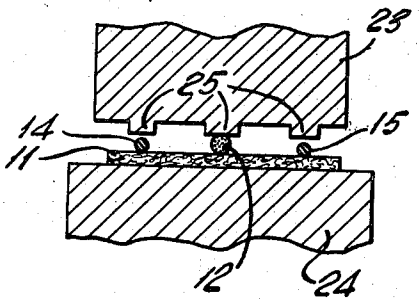


Fig. 3.

Fig. 4.



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3,837,950

SURGICAL SPONGE

Harry G. Reimels, Braintree, Mass., assignor to Codman & Shurtleff, Inc.

Original application Feb. 17, 1971, Ser. No. 116,187, now Patent No. 3,736,935. Divided and this application Oct. 13, 1972, Ser. No. 297,583
Int. Cl. B32b *31/20*
U.S. Cl. 156—73 5 Claims

ABSTRACT OF THE DISCLOSURE

A surgical sponge useful for delicate surgical procedures is made by providing a strip of nonwoven fibers which are securely bonded against delamination, and bonding a plastic retrieval thread to the surface of the strip by heat-softening a portion of the thread to cause it to flow partially into the surface of the strip. The resulting sponge may also have a band of radiopaque material bonded to its surface by heat-softening the plastic material of the band.

This is a division of application Ser. No. 116,187, filed Feb. 17, 1971, now U.S. Pat. No. 3,736,935.

Background of the Invention

This invention relates to surgical sponges and, more particularly, to surgical sponges suitable for use in laminectomies, craniotomies, nerve surgery or other delicate surgical procedures.

It has been the practice in the above types of surgery to utilize a relatively small, thin strip of bonded nonwoven fibers as a sponge. This type of miniature sponge is necessary because of the small operating field and the delicate nature of the procedure. However, because of its size, it is necessary to attach some means, such as, a retrieval thread, to the sponges in order to insure that the sponges will not be left in the wound and to provide a "handle" for applying and withdrawing the sponges from the wound site.

Prior surgical sponges of this type utilized retrieval threads that were stitched directly to one or both surfaces of the sponge and often, when desired, a strip of radiopaque material was combined with the thread and simultaneously stitched to the sponge. When fabricated in this manner, the sponges were rough on both sides, in that the stitching extended entirely through the sponge. Also, the combination of retrieval thread and radiopaque material was unsafe because the accidental release of one elemental would result in the release of the other element, thus, rendering the sponge free of detection means and capable of being inadvertently left in the wound.

In addition, the stitching operation utilized to fabricate the sponges was necessarily a hand operation resulting in an excessively large manufacturing cost.

Summary of the Invention

The disadvantages of the prior surgical sponges are eliminated by the present invention which provides a unique sponge construction comprising a strip of nonwoven bonded fibers having a plastic retrieval thread secured to one surface thereof solely by a flattened portion of the thread that has been heat-softened to flow partially into and between the fibers of the strip.

One or more bands of radiopaque material may also be bonded to the surface of the sponge in the same manner and at the same itme, but at a different location, as the plastic retrieval thread.

The various elements of the sponge may be simultaneously fabricated by properly positioning the strip, plastic retrieval thread and radiopaque bands under the horn of

an ultrasonic welding device and then bringing the horn into contact with the thread and bands.

Thus, in a single manipulative step, an improved surgical sponge may be fabricated which possesses numerous advantages over all known prior 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 drawings, wherein:

FIG. 1 is a plan view of the surgical sponge of the present invention with portions broken away for clarity;

FIG. 2 is a cross sectional view taken along line **2—2** in FIG. 1;

FIG. 3 is a side elevational view schematically illustrating the process for manufacturing the surgical sponge shown in FIG. 1;

FIG. 4 is a cross sectional view taken along line **4—4** in FIG. 3; and

FIG. 5 is a plan view of another embodiment of the surgical sponge with parts broken away for clarity.

Referring to FIGS. 1 and 2, the preferred embodiment of the surgical sponge of this invention is shown generally at **10** and is constructed from a relatively thin strip of nonwoven fibers **11** which have been securely bonded together to prevent delamination or "linting" of the fibers. Strip **11** is preferably constructed from rayon fibers which have been carded in a well known manner and then needle loomed into sheets, which sheets are then cut into strips of the desired length and width. The rayon fibers are preferably a dull, virgin, 3 denier rayon with a nominal staple length of approximately 1⅛". This type of material has been manufactured and used for surgical sponges in the past and it has been found that, when bonded with a mixture of starch and polyvinyl alcohol, the strips will retain their integrity and the material has been tested and found to absorb in excess of 25 times its weight in water.

A retrieval thread **12** is bonded to one surface of strip **11** and comprises a flattened portion **13** which has been heat-softened to provide a secure bond between thread **12** and the surface of strip **11**. As stated above, surgical sponge **10** is primarily intended for use in very delicate surgical procedures and the operating field is considerably smaller in this type of operation than is normally found in more massive surgery. For this reason, the relatively small, thin sponges are used and a means must be provided in association with these sponges for retrieving them after they have been applied to a wound site and have absorbed a considerable amount of body fluid. Retrieval thread **12** has been provided for this purpose and the bond between the thread and the surface of strip **11** is, therefore, very important. The length of thread **12** is not critical so long as it can be placed at a sufficient distance outside the wound to be recognizable and easily handled by the surgeon and his assistants.

Retrieval thread **12** is preferably made from a continuous multifilament polyester fiber. However, it has been found that other plastic materials, such as, nylon and polypropylene will also provide a secure bond. However, the polyester material results in the best combination of end product properties, such as, strength of bond and softness of the thread.

In addition to retrieval thread **12**, a pair of bands **14** and **15** composed of radiopaque material is also securely bonded to the surface of strip **11**. Although two bands of radiopaque material are illustrated in the preferred embodiment of this invention, it will be appreciated that only one band may be desirable for exceptionally small surgical sponges and two or more may be utilized in larger sponges. Although numerous radiopaque materials may be usable with this invention it has been found that vinyl with barium sulfate dispersed therein is very effec-

tive and forms a very secure bond with the surface of strip **11**.

The preferred method for manufacturing the surgical sponge of the present invention is an important part of the invention and will now be described in detail. Referring to FIG. 3, the procedure for heat-softening the retrieval thread **12** and the radiopaque bands **14** and **15** is schematically illustrated. In order to avoid the necessity of utilizing additional materials, such as, adhesives, and in order to eliminate the deleterious effects of the application of heat to obtain the necessary bond between the retrieval thread **12**, bands **14** and **15** and the surface of strip **11**, an ultrasonic welding device has been adopted. This device is specifically described in U.S. Pat. No. 3,440,117 and comprises a radio frequency generator **20**, a conductor **21** for transmitting alternating current energy at about 20 kilocycles per second from the generator **20** to a sonic converter unit **22**. Sonic converter **22** is fitted with a horn **23** for transferring sonic energy to the thread **12** and bands **14** and **15**. The sonic converter **22**, generally, is a device which converts electrical energy to mechanical vibration and, to this end, includes one or more piezoelectric discs which vibrate under the influence of alternating current in electrical energy. The vibrations are amplified and appear as longitudinal vibration at the tip of horn **23**.

In order to accomplish the simultaneous assembly of all of the elements of the surgical sponge **10**, strip **11** is placed upon a support member **24** which is located directly below ultrasonic welding arm **23**. Retrieval thread **12** and bands **14** and **15** are then placed upon strip **11** substantially as shown in FIG. 1. Referring to FIG. 4, the lower portion of horn **23** has been specially constructed so that a plurality of ribs **25** extend downwardly therefrom. Ribs **25** are constructed to contact only so much of the material of retrieval thread **12** and bands **14** and **15** as is necessary to sufficiently heat-soften the materials so that they will flow into the upper surface of strip **11** and form a secure bond between the material and the fibers that comprise the surface. As can be seen in FIG. 2, the action of horn **23** on the upper surfaces of thread **12** and bands **14** and **15** substantially flattens these materials and forces them into the upper surface of strip **11** and firmly bonds them to said surface.

In some instances, e.g. where a more flexible surgical sponge is desired, it has been found to be desirable to reduce the area of the bonding interface between strip **11** and retrieval thread **12**. The preferred sponge construction for accomplishing this is illustrated in FIG. 5 wherein the sponge **10***a* comprises a strip **11***a* having a retrieval thread **12***a* bonded to the surface thereof. However, unlike the sponge in FIG. 1, the bond occurs only at spaced intervals B along the length of partially flattened portion **13***a* on thread **12***a*. The unbonded areas act as "hinges" and, thus, provide regions of increased flexibility.

In order to provide this type of bond, ribs **25** on the lower portion of horn **23** (see FIG. 4) may be longitudinally notched so that contact is made between horn **23** and retrieval thread **12***a* only at the predetermined spaced intervals, thus, creating a bond at only such intervals.

It will thus be apparent that the present invention provides a unique surgical sponge construction that has many advantages over the prior known sponges. By eliminating the need for stitching or utilizing adhesives, a surgical sponge can now be constructed that is completely smooth on one side for application to the wound site. In addition, the radiopaque bands may now be applied at a location different from that of the retrieval thread and thereby provide additional safety in the event that the retrieval thread is accidentally pulled away from the surface of the strip. It will also be apparent from the foregoing specification that the method of manufacturing the surgical sponge of this invention is extremely economical in that all of the parts may be assembled in one operation and no additional materials, such as, adhesives are required in the assembly of the parts.

What is claimed is:

1. The method of making a surgical sponge useful for delicate procedures, comprising the steps of: forming a strip of bonded nonwoven fibers; placing a plastic retrieval thread and a band of radiopaque material into contact with the surface of said strip and heat-softening said thread and said material to cause a portion of said thread and said material to flow into said surface to create a bond therebetween.

2. The method of claim **1** wherein said thread and said radiopaque material are heat-softened by contacting them with an ultrasonic welding horn.

3. The method of claim **2** wherein said thread and said radiopaque material are simultaneously contacted by said horn.

4. The method of claim **3** wherein said nonwoven fibers are rayon, said thread is a continuous multifilament of polyester and said radiopaque material is vinyl containing barium sulfate.

5. The method of claim **1** wherein said thread is heat-softened at spaced intervals.

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EDWARD G. WHITBY, Primary Examiner

U.S. Cl. X.R.

128—290 W, 296; 156—290