Jan. 31, 1967 G. A. CROWE, JR., ETAL 3,301,257

ABSORBENT SURGICAL DRESSING

Filed July 15, 1963 2 Sheets-Sheet 1

Fig. 1.

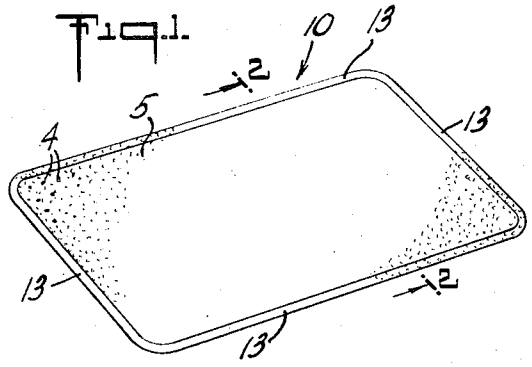


Fig. 2.

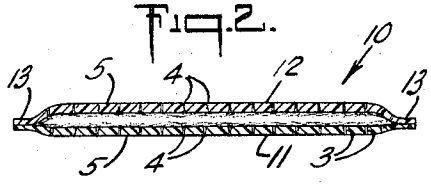


Fig. 3.

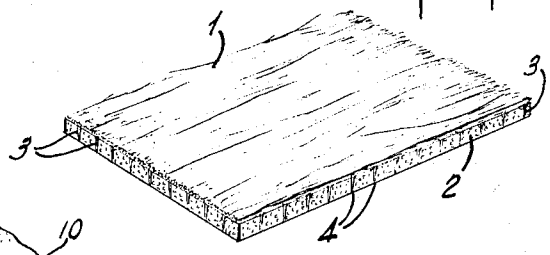


Fig. 4.

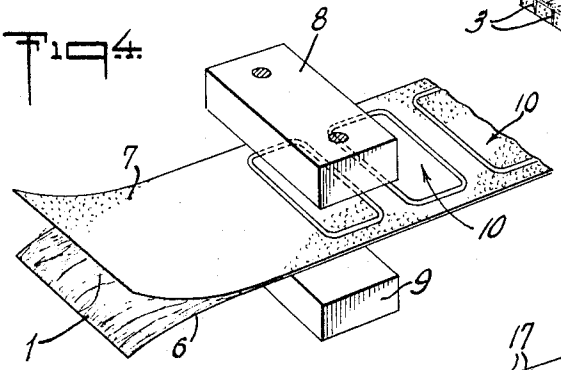


Fig. 5.

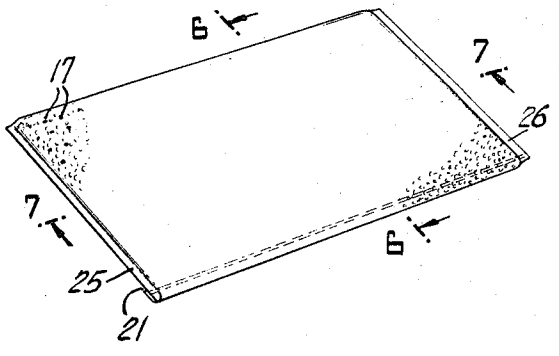


Fig. 6.

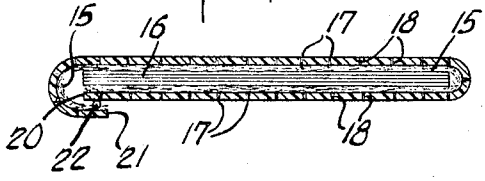


Fig. 8.

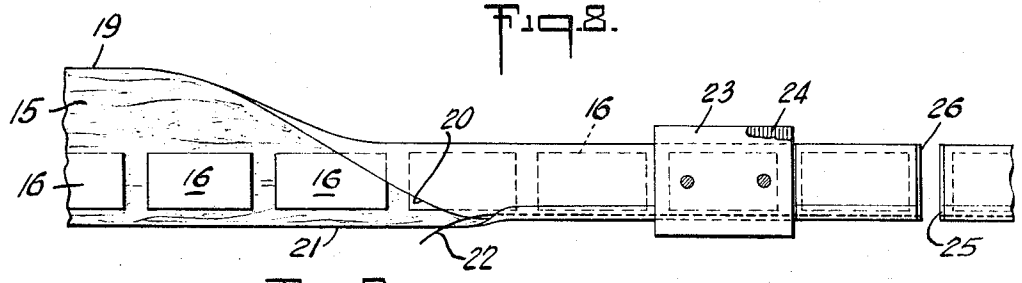
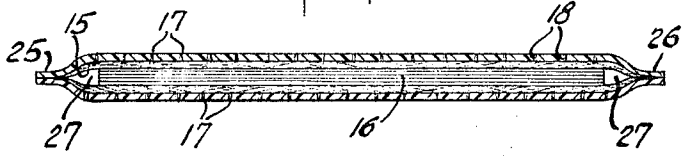


Fig. 7.



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ABSORBENT SURGICAL DRESSING

Filed July 15, 1963 2 Sheets-Sheet 2

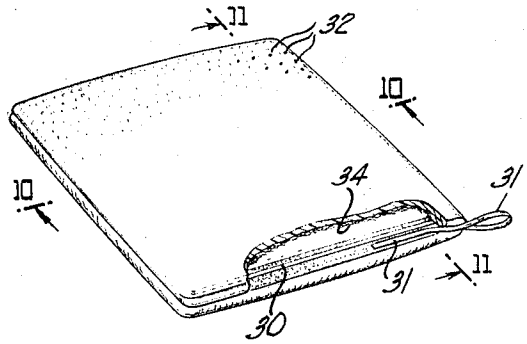


Fig. 9.

Fig. 10.

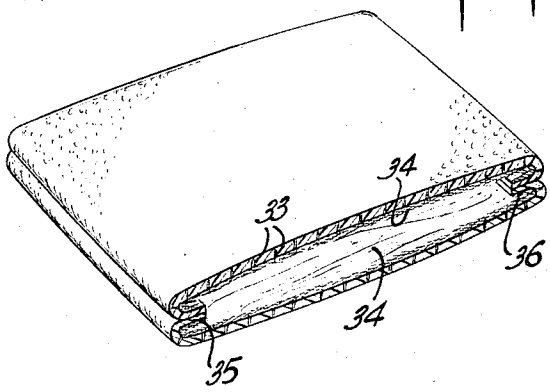


Fig. 11.

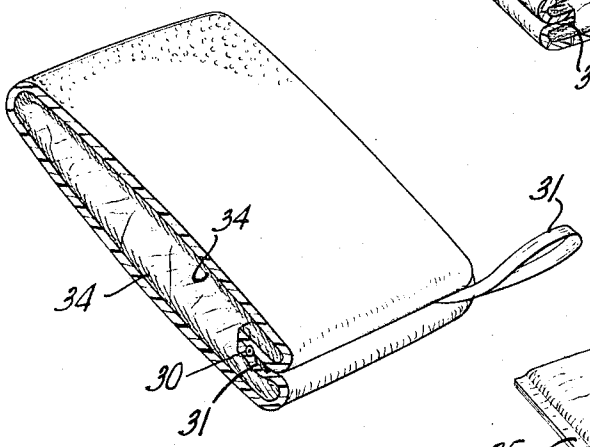


Fig. 13.

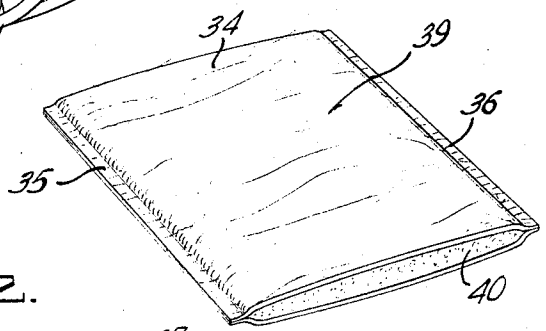
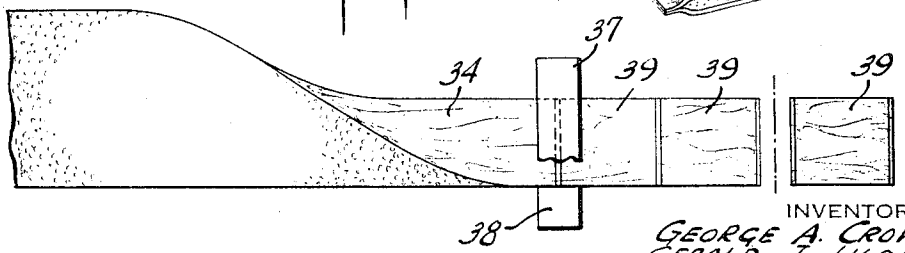


Fig. 12.



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ABSORBENT SURGICAL DRESSING

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Filed July 15, 1963, Ser. No. 295,094
17 Claims. (Cl. 128—296)

The present invention is drawn to composite dressings, compresses and the like formed of cellular sponge sheet materials.

In copending application Ser. No. 283,485, there is described a new type of absorbent sheet formed of cellular sponge sheet containing fluid-conducting fiber bundles extending from one surface of the sheet to the other. Where the surface of the sponge sheet is hydrophobic in nature, either because of the material from which the sponge is made or because of treatment of the surface with a water repellent, the surface provides nonabsorbing and absorbing areas, the ends of the fiber bundles providing the absorbent areas. The present invention is directed to surgical dressings using sheet materials of this general type, wherein an absorbent fiber web is completely enclosed and sealed within the dressing and fluids are conducted by means of such fiber bundles from the dressing surface to the absorbent fiber webs or layers sealed therein.

The sheet materials used in making dressings of the present invention are formed by laying a web of hydrophilic fibers on one surface of a sheet of cellular sponge material and then passing barbed needles down through the web of fibers into the sponge sheet. This forces a portion of the fibers of said web, in the form of fiber bundles, through the main body of the underlying sponge sheet. The needles are adjusted so that the ends of the fiber bundles just clear the other side of the cellular sponge sheet. The ends of the bundles passing through the cellular sponge sheet are then preferably sheared to avoid fibers extending any appreciable distance beyond the sponge sheet surface and are then preferably ironed down into the sponge sheet surface to further flatten out protruding fibers.

As indicated in copending application Ser. No. 283,485, absorbent sheet materials of the type described may be used singly or in combination for many purposes, including the treatment of wounds. It is an object of the present invention, however, to make surgical dressings, using particular sheet materials of this general type, in which the portion of the dressing adapted to hold absorbed fluids is completely contained within the cellular sponge sheet, fluid being conducted thereto through the heretofore-mentioned fiber bundles, and the dressing being sealed around its entire edge to seal in the portion of the dressing adapted to hold absorbed fluids.

A further object of the present invention is to form such sealed dressings with fiber-reinforced sealed edges.

A still further object is to form soft, absorbent, air-previous surgical dressings having cellular sponge surfaces in which the cellular structure of the sponge will not deleteriously effect the surface of healing wounds.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings, wherein are set forth by way of illustration and example certain embodiments of the invention.

In practicing the present invention, any cellular sponge material may be used that is sufficiently flexible and resilient for the purpose intended. Where the sponge material itself is not of a hydrophobic nature, the surface thereof may be treated so that the surface through which the fiber ends extend is relatively hydrophobic, i.e., not readily wetted with water. It is, however, preferred that

hydrophobic sponge materials be used. The sponge sheet must be readily flexible and conforming in sheets up to as much as ½ inch in thickness and should be soft and resilient in nature. The sponge sheet preferably has a flexibility of 17–74% of original thickness and a resiliency of 78–98% of original thickness. The flexibility and resiliency are measured with a micrometer having a dead weight of 56.7 grams per square inch of sample. A 500 gram weight is added, and the thickness is read after 60 seconds to find flexibility. The 500 gram weight is removed, and after 60 seconds the thickness is read to find resiliency. Results are expressed in terms of percentage of original thickness. Although any hydrophobic sponge sheet which is non-toxic to open wounds can be used as long as it has the above-indicated flexibility and resiliency, it is preferred in making the dressings of the present invention to use polyurethane foam materials either of the polyester or the polyether type. These polyurethane foams are generally open-cellular in nature, either by special treatment or by rupture of a sufficient number of cell walls during handling and during the needling process to give an open cellular sponge material. It is generally preferred that the cellular sponge sheet have a sufficiently open-cellular structure, prior to needling on a web of fibers, that a sheet of 0.04 inch thickness will have an air permeability of at least 85 liters of air per minute per square inch of sponge sheet at an air pressure difference of 0.50 inch of water height.

Besides being flexible and resilient, the cellular sponge sheet used should generally not have a cell size, on the average, larger than about 15 cells per linear inch nor smaller than about 100 cells per linear inch. When the dressing is to be kept in contact with the wound until after reepithelialization, it is preferable that the cell size not exceed about 40 cells per linear inch, as a healing wound surface over which the dressing is used tends to grow into the cells where the cells are much above this size. Where the cell size is much smaller than about 100 cells per linear inch, the foam sheets are generally not sufficiently porous and also lose some of their desired softness.

Although sponge sheets of substantial thickness can be used in making the dressings of the present invention, care should be taken that the sponge sheet is not so thick that the lateral squeeze of the sponge material on the fiber bundles passing therethrough will be sufficient to squeeze the fibers together to the point of blocking off most of the capillary spaces or channels that would otherwise exist between the same. The maximum thickness of the cellular sponge sheet used is, accordingly, dependent to some extent on the resiliency of the sponge material used. Also, as a practical matter where the cellular sponge sheet is too thick, it is difficult to form satisfactory dressings of the type herein described. It is, accordingly, preferred that the thickness of the cellular sponge sheet not exceed about ¼ inch. The only practical limit as to the thinness of the cellular sponge sheet is its strength. It has been found that excellent dressings are prepared by using polyurethane foam sheets having an average of 60 cells per linear inch and a thickness of about $\frac{1}{32}$ inch.

The fibers used in forming the web of hydrophilic fibers and the fiber bundles are preferably rayon fibers having a length of about ½ to 3 inches, the preferred length being about 1½ inches. Also, the denier of the fibers used should be about 1 to 6, the preferred denier being in the range of 1.5 to 3.0. Where the denier is too fine, the fibers are difficult to handle and tend to break during the needling operation, giving unsatisfactory fiber bundles and short fiber ends that may not be fully tied down. Where the denier is too great, although satisfactory fiber bundles can be obtained, the absorbent ca-

pacity of the fiber web is found to be substantially reduced. Accordingly, where no other absorbent is used other than the fiber web, deniers as high as 4 and ½ have been found to be unsatisfactory for absorbent capacity, although still giving excellent fluid-conducting bundles.

According to the present invention, the dressings are formed from the fiber-sponge sheets by placing two sheets together with the fiber web portion of each facing inwardly and then sealing the sheets around the edges so as to fully enclose the fiber webs contained therein. The two sheets may be either two separate sheets which are superimposed in the manner described or may be formed of one sheet which is folded over, thus giving a top and bottom sheet joined together along one edge by the fold, the remaining edges then being secured to give the finished dressing.

The fiber web, which is needled onto the foam sheet as above described to form the absorbent layer of fibers and the conducting fiber bundles, is generally not more than about 5 ounces weight of fibers per square yard. Fairly heavy fiber webs may be needled into the base foam sheet. However, the heavier the fiber web, it is found that the more it is compacted during the needling process with a resulting decrease in its absorbent capacity for weight of fibers used. Thus, increasing the weight of the fiber web alone to weights above 5 ounces per square yard, substantially increases the cost of the dressing with very little improvement in its absorption capacity, the weight of fibers used in forming the fiber web which is needled into the base foam sheet is, accordingly, maintained within the range of about ½ ounce to 5 ounces per square yard, the preferred weight generally being about 0.7 to 3.0 ounces per square yard. Where a heavy duty dressing is desired which is to absorb substantial amounts of fluid, a further absorbent layer is introduced between the two fiber webs. This may be cellulose wadding or any other highly absorbent material.

The edge sealing of the dressings of the present invention may be done in several ways, the manner of sealing depending to a considerable extent on the particular type of dressing being formed. Thus, where the dressing is to be used for placing over wounds on the outside of the body, it is preferred to form either a part or all of the seal by heat and pressure, the seal being formed directly through the fiber webs which extend between the sealed edges. Where, however, the dressing is to be used inside the body, as, for example, are laparotomy sponges, the sealed edge is so formed as to be contained within the sponge and thus avoid any irritation that may otherwise occur from the somewhat stiffer nature of the seal. Where the seal is formed in this manner, the seal is made between the two sponge sheet surfaces in the manner hereinafter more fully described rather than through the fiber web. The seal in each instance, however, is enforced by fibers being contained therein. As it is generally preferred that the cellular sponge sheet material used to be substantially less in thickness than ¼ inch, the reinforcing of the seal by the fibers present therein adds substantially to the strength of the resulting dressing, the sealed edges being substantially stronger than could be obtained by the sealing of the sponge material itself without the presence of any reinforcing fibers.

Where the seal at the edge of the sponge is made by sealing the sponge sheets together through the fiber webs formed thereon, it is necessary in order to obtain a satisfactory seal, particularly at lower sealing temperatures, to blend with the rayon fibers, thermoplastic fibers. The thermoplastic fibers should be present in amounts of at least 5% of the total fiber web and preferably should be present in amounts of 9% or more where fibers having a denier of about 1 and ½ are used, with somewhat larger amounts of thermoplastic fibers preferably being used where larger denier fibers are employed. As the dressings are subjected in hospitals to steam sterilization, the thermoplastic fiber employed should be one which will not soften at normal steam sterilizing temperatures. However, the fiber should also be one which will soften at temperatures below that which would tend to discolor the polyurethane or other cellular sponge sheet used. Although sealing can be obtained where a thermoplastic sponge sheet material, such as polyurethane foam, is employed by heating to a sufficiently high temperature to melt the sponge sheet and cause it to flow between the fibers, this causes degradation with resulting discoloration of the thermoplastic sponge material, particularly where the same is a polyurethane foam. Accordingly, in the preferred practice, thermoplastic fibers are employed. The preferred thermoplastic fiber, particularly for use with polyurethane foam sponge sheets, is polypropylene, the fiber having a melting range of 320–340° F.

In order to aid in further describing the invention, reference is made to the accompanying drawings in which:

FIG. 1 is a perspective view of a dressing made in accordance with the present invention;

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

FIG. 3 is an absorbent fabric of the type used in making the dressing of FIG. 1;

FIG. 4 is a schematic view illustrating a portion of the process of manufacture of the dressing of FIG. 1;

FIG. 5 is a perspective view of another type of dressing made in accordance with the present invention;

FIG. 6 is a cross-sectional view taken along line **6—6** of FIG. 5;

FIG. 7 is a cross-sectional view taken along line **7—7** of FIG. 5;

FIG. 8 is a schematic view illustrating the manufacture of the dressing of FIG. 5;

FIG. 9 is a perspective view of another type of dressing made in accordance with the present invention;

FIG. 10 is a perspective view taken along line **10—10** of FIG. 9;

FIG. 11 is a perspective view taken along line **11—11** of FIG. 9;

FIG. 12 is a schematic view illustrating a portion of the process for forming the dressing of FIG. 9; and

FIG. 13 is a detail showing the partially formed dressing of FIG. 9.

Referring to the drawings, the dressing illustrated in FIG. 1 is adapted for the treatment of relatively light wounds where particularly large fluid-absorbing capacity is not required. The dressing is formed from a sheet of absorbent materials, such as that illustrated in FIG. 3, wherein fiber web **1** is secured to a polyurethane foam sheet **2** by needling fibers from the web down through the foam sheet to form fiber bundles **3**, the ends **4** of which terminate near the surface **5** of the polyurethane foam sheet to form fluid-absorbing, i.e., fluid-conducting, areas thereon. The polyurethane foam sheet itself has a thickness of 0.04 inch, a flexibility of 74%, and a resiliency of 98%. As the polyurethane foam or sponge sheet **2** exerts only a relatively slight lateral squeeze on the fiber bundles **3**, the individual fibers in the bundles are relatively loosely compacted having substantial capillary spaces therebetween.

The fiber web **1** is at a weight of about 2.1 to 2.7 ounces per square yard, the fibers being a mixture of rayon fibers having a denier of 3 and a length of 1 and 9/16 inches and polypropylene fibers having a denier of 1.5 and a length of 1.5 inches. The rayon fibers, which are present in the fiber mix in an amount of about 91%, have been treated with a small amount of a softening and wetting agent, such as a polyoxyethylene sorbitan monolaurate, in accordance with the teachings of Pat. No. 2,821,489. This gives a softer and more readily wettable fiber than the untreated rayon. The absorbent sheet of FIG. 3 contains about 120 fiber bundles to the square inch. Also, the cellular structure of the polyurethane foam sheet **2** is such as to have on the average 60 cells per linear inch of the foam sheet material.

Using absorbent sheet material, such as that illustrated in FIG. 3, the dressing of FIG. 1 is prepared by taking two sheets **6** and **7** of the absorbent sheet material of FIG. 3 and superimposing the same, with the fiber web of one superimposed on the fiber web of the other, as illustrated in FIG. 4. The dressings are then formed by passing the two superimposed sheets **6** and **7** between a pair of heated dies **8** and **9** which, when brought together, bond the two sheets **6** and **7** together through heat and pressure around the periphery of the dressing **10** to form the composite dressing of FIG. 1. The dressings may be severed during the dieing operation or may be severed and trimmed after the sheets are bonded together.

The dressing of FIG. 1 comprises two sheets of the type illustrated in FIG. 3 with the absorbent web **1** completely enclosed within the dressing with the outer surface **5** of the polyurethane foam sheet and the fiber bundle ends **4** on the outside. The fiber bundle ends **4** may either slightly protrude or may be substantially flush with the outer surface of the dressing, particularly where sheared and ironed as previously described.

In forming the dressing, it is preferred that the dies be so shaped that the dressing formed is substantially flat on one side **11**, as illustrated in FIG. 2. The other side **12** is raised with respect to the sealed edge **13**. However, the dressing may be formed, if desired, with both sides raising slightly from the relatively thin compressed dresing edge **13**, in which case the dressing would have, particularly for quite small dressings, a pillow-like appearance.

The heat and pressure seal made at the peripheral edge **13** extends through the fiber web. The thermoplastic fibers contained in the fiber web not only aid in bonding the fibers of the web together in the area of the seal, in bonding together the superimposed fiber web surfaces, and in bonding the fiber webs in the area of the seal to the polyurethane foam sheet, but also the thermoplastic fibers of the fiber bundles which extend down through the polyurethane foam sheet **2** fuse and act as rivets, giving a much firmer bond at the edge than would be obtained through the fusing of the thermoplastic fibers in the fiber web alone. This so-called riveting action of the fiber bundles **3** along the sealed edge is of particular importance where the seal is made through the fiber web, as described in the construction of FIG. 1, particularly where the sealing temperature, although above the fusing temperature of the thermoplastic fibers, is below the softening or fusing temperature of the polyurethane foam or other thermoplastic cellular sponge sheet material used. For example, with fiber webs of a weight of 2.4 ounces per square yard, where fiber foam materials such as illustrated in FIG. 3 are used, there would be a double fiber web thickness at the sealed joint of 4.8 ounces per square yard. With polyurethane foam sheet thicknesses of 0.04 inch and with no fiber bundles extending through the foam sheet, it would be necessary to use a temperature of about 490° F. and a pressure of about 2000 pounds per square inch in order to obtain a satisfactory seal through the fiber web with the same mixture of thermoplastic and nonthermoplastic fibers, namely 91% rayon fibers and 9% polypropylene fibers. This bond would result from the fusion of the thermoplastic fibers as well as the fusion of the polyurethane foam sheet in the area of the seal. However, at such elevated temperatures, the polyurethane resin forming the foam sheet would tend to break down, giving a substantial discoloration or yellowing to the foam sheet material. A successful seal in such instance cannot be obtained at a temperature as low at 450° F. which is a temperature sufficiently high to cause fusion of the thermoplastic fibers without material degradation of the polyurethane. In such instance, the polyurethane foam or sponge sheet itself would not be fused, and without the fiber bundles **3** a satisfactory seal could not be obtained. However, an excellent seal is obtained where the fiber layer is needled into the polyurethane foam sheet so that bundles of fibers, including thermoplastic fibers therein, actually extend down into the polyurethane foam sheet material along the line on which the seal is to be made. Where the seal is thus made in areas containing the fiber bundles, with the thermoplastic fibers contained therein, an excellent seal is obtained with pressures of about 2000 pounds per square inch and temperatures of 450° F., these temperatures being well below the temperature of 490° F. found to be necesasry in order to obtain a satisfactory seal through the fiber layer in the absence of such rivet-forming fiber bundles in the sealed area. For the best results, it is generally preferred to have these rivet-forming fiber bundles in the seal area spaced from each other no more than about 0.40 inch.

In making the fiber-cellular sponge sheet materials of FIG. 3, there is a distinct tendency for the sheet material, particularly where made in a long continuous strip, to become extended in the direction of feed. This is probably due to the fiber bundles being pressed down through the sponge sheet while the same is under tension in the direction of the sponge sheet movement through the needling apparatus. It has been found that where using polyurethane foam sheets as the sheet sponge material in the manufacture of the sponges of FIG. 1, there is a tendency for the sponges, after forming, to curl on later sterilization. This curling is apparently due to a relaxation that takes places on sterilizing, which results in a slight shrinkage in the opposite direction to that of the direction of sheet movement during needling and sealing. This curling is particularly noticeable in rectangular dressings where the direction of sheet movement during manufacture is essentially parallel to the longitudinal axis of the finished dressing. By forming these dressings with their longitudinal axes at right angles to the movement of the sheet material from which they are formed, as illustrated in FIG. 4, this tendency to curl can be substantially reduced. Accordingly, in the manufacture of rectangular or other elongated sponges, the two fiber-foam sheets **6** and **7** are superimposed together as heretofore described, with the fiber-containing sides coming in contact, and the elongated sponges are then died out with heat and pressure sealing dies **8** and **9** with the lengthwise axis of the dressing **10** extending crosswise of the direction of travel of the fiber-cellular sponge sheet material from which the same is formed.

In the modification illustrated in FIGS. 5–8, the dressing is designed to have a substantially larger absorbent capacity than that of the dressings of FIG. 1. To give this extra absorbent capacity, the dressing contains, besides the absorbent web **15**, an additional absorbent filler **16**, as illustrated in FIG. 6. This additional absorbent may be any suitable highly absorbent material, such, for example, as the absorbent cellulose paper sheets, generally referred to as cellulose wadding, shown in the drawing. Fluids drawn into the dressing through the ends **17** of the fiber bundles **18** first wet out the fiber web **15** and from there contact the cellulose wadding or other absorbent material **16** which is placed between the two fiber web surfaces. The absorbent capacity of the dressing so formed will, of course, depend on the amount of absorbent material contained therein.

With the inclusion of the extra absorbent material, a dressing, if formed in the manner described in the sponge of FIG. 1, would be generally too bulky or pillowy, particularly if a substantial amount of extra absorbent were included. It is found that by using the dressing structure illustrated in FIGS. 5–8, an excellent dressing, having a high fluid capacity, can be readily made. The manufacture of these dressings is best illustrated by FIG. 8.

Referring to FIG. 8, a continuous sheet **19** of fiber-cellular sponge material, such as illustrated in FIG. 3, is fed along a conveyor with the side containing the fiber web **15** uppermost. Absorbent pads **16**, formed of several sheets of superimposed cellulose wadding, are placed on the moving web **19** in spaced relation to each other as the

web passes by apparatus, not shown, for depositing such absorbent. The fiber-sponge sheet **19** is then folded over on itself so as to completely cover the inserted absorbent pads **16**, the edge **20** of the folded-over portion stopping slightly short of the edge **21** of the underlying half of the fiber-cellular sponge sheet, as illustrated in FIG. 8. A thread **22**, such as cotton yarn, saturated with an adhesive, such as a reacted polyurethane emulsion adhesive or a polyvinyl acetate emulsion adhesive, is then fed along the outer edge **20** of the folded-over half of the sheet **22** on the cellular sponge side. The edge **21** of the lower half of the sheet **19** is then folded over to give an adhesive seal between the two edges **20** and **21**, as best illustrated in FIG. 6. After insertion of the adhesive-coated thread and folding-over of the edge **21**, the folded-over edge is pressed into intimate contact with the underlying adhesive-coated thread **22** so that the adhesive of the thread will penetrate through the fiber layer **15** and contact the underlying foam to bond the two edges firmly together. The composite sheet is then passed between heated dies **23** and **24**, the dies forming seals **25** and **26** between the absorbent inserts **16**, the seals being similar to the seals forming the sealed edges **13** of the dressing of FIG. 1. The dressings so formed may then be separated by cutting along the seal lines **25** and **26**. The cutting operation can take place at the same time that the seals are made or may be done later. Referring to FIG. 7, it will be noted that there is an appreciable space **27** between the edge of the absorbent filler **16** and the sealed edges **25** and **26**, the reason for this being to avoid abrupt rise of the dressing surface from the relatively thin sealed edges **25** and **26**. Due to the insertion of the extra absorbent material **16**, there is less tendency for the dressing to curl on later sterilization even though the dressings may be formed with the long axis of the dressing extending in the same direction as the axis of feed of the fiber-cellular sponge sheet during the manufacture of the dressing. Accordingly, it is not as important that the dressing, in manufacture, be formed so that the longitudinal axis of the dressing is at right angles to the direction of the web feed.

The dressing of FIGS. 9–11 is designed primarily for internal use during operation, such, for example, as in abdominal operations where it may be placed against the abdominal wall to help maintain the same moist during the operation. Such dressings are generally referred to as laparotomy sponges. As the dressing is designed primarily for internal use, rough or harsh edges are avoided and the dressing is provided with an X-ray detectable insert **30**, such as a ribbon treated with barium sulfate, and a loop **31** for securing to a cord or lead extending outside of the operation site to minimize danger of the dressing being left inside of the patient.

The dressing has no exposed compacted areas or edges, such as do the previous dressings described, all of the seals being contained within the dressing. As a result, the entire outer surface is formed of the soft cellular sponge sheet material used except for the absorbent bundle ends **32**. As the main purpose for sponges of this type is to block off an operational area or to keep the site of an operational area moist, the amount of absorbent fibers contained within the sponge are substantially less than that used, for example, with dressing of the type illustrated in FIGS. 1 and 5.

The dressing of FIGS. 9–13 is prepared from fibrous cellular foam sheet material of the type previously described and, for example, illustrated in FIG. 3. However, as previously indicated, the fiber web itself is not as heavy as the fiber webs employed in the manufacture of the previously-described dressings, the fiber web preferably having a weight of about 0.8 to 2.0 ounces per square yard. Also, the number of fiber bundles **33** is preferably somewhat less than the number of fiber bundles used in making the previously-described dressings, the number generally being in the order of about 50 to 70 per square inch. Where it is desired that the dressing keep a protected area moist, the dressing is first wetted with physiological saline solution. The fiber bundles which draw this fluid into the dressing also act to permit fluid to move from the center of the dressing to the surface thereof where the dressing has first been saturated. This helps to keep the surface moist. Where the dressing has not been saturated, these same fiber bundles remove fluids from the surface and carry the same into the enclosed absorbent body in the same manner as with the previously-described dressings.

In manufacturing the dressings of FIGS. 9–13, a fiber-foam sheet, such as illustrated in FIG. 3, is turned over on itself with the fiber web **34** outside as illustrated in FIG. 11. Seals **35** and **36** are then formed across the folded sheet with heated dies **37** and **38** through heat and pressure. As the seal in this instance is thermoplastic sponge surface against thermoplastic sponge surface, substantially less heat and pressure is needed than where sealing through a fiber layer, as all that is necessary is to have a slight softening of the cellular sponge material for sealing to take place. Accordingly, it is not necessary to include thermoplastic fibers in the fiber web **34**; however, the same may be included if desired. The pockets **39**, so formed, are then cut along the seal lines **35** and **36** to form separate pockets, as illustrated in FIG. 13. Each of these pockets **39** have the fiber web **34** on the outside, an open end **40** and side seals **35** and **36**. The pockets **39** are then turned inside out so that the fiber web **34** and the seals **35** and **36** are now contained on the inside and the sponge sheet surface with the fiber bundle ends on the outside, as illustrated in FIG. 10. The open end of the pocket is then turned in, and the X-ray detectable strip **30** and the ends of the tape forming the loop **31** placed along the in-turned edge, and the in-turned edges then sealed together with an adhesive to completely seal the absorbent web **34** within the dressing. The resulting dressing has no exterior seals and presents on its outer surface only the soft, resilient polyurethane sponge sheet with the absorbent bundle ends. The fibers in the seal, both in the heat and pressure sealed edge and in the adhesive sealed edge, strengthen the sealed edges of the dressing.

Having thus described our invention, we claim:

1. In an absorbent dressing

an outer covering of cellular sponge sheet material comprising a first and second panel,

an absorbent contained between said first and second panel, means to transmit fluids from the outer surface of at least one of said cellular sponge panels to said absorbent and

a fiber-reinforced seal between at least a major portion of the edges of said first and second panels, the sponge sheet throughout at least a major portion of said fiber reinforced seal being compacted through heat and pressure to form said seal, said fibers in said seal acting to reinforce the same and strengthen said dressing.

2. An absorbent dressing of claim **1** in which fiber bundles extend down through said sponge sheet at said seal.

3. An absorbent dressing of claim **1** in which fiber bundles extend down through said sponge at said seal and contain fused thermoplastic fibers.

4. A dressing of claim **1** in which at least a portion of said absorbent consists of a fiber web joined to the inner surface of at least one of said panels by fiber bundles extending from said fiber web through said panel, said fiber web extending to the edge of said panel and fibers of said web near the edge of said panel being contained within said seal and acting to reinforce the same.

5. A dressing of claim **4** in which at least 5% by weight of the fibers of said fiber web are thermoplastic fibers.

6. A dressing comprising
an absorbent web of hydrophilic fibers
contained between two panels of cellular sponge material which form the outer cover of said dressing, said cellular sponge material on the outer surface of said dressing being hydrophobic in nature, and said panels being joined together around their edge to seal said absorbent web within said dressing,
a portion of the fibers of said web extending down through and to the opposite side of at least one of said panels of cellular sponge material in the form of fiber bundles, the fibers forming said bundles being sufficiently loosely compacted to provide capillary fluid-conducting channels therebetween, the ends of said fiber bundles terminating near the outer surface of said panel and forming fluid-absorbing areas on said surface,
said fibers forming said web having a denier of 1 to 6 and the cellular sponge material forming said panels having a flexibility of 17 to 74%, a resiliency of 78 to 98% and a pore size of 25 to 100 pores per linear inch.

7. A dressing of claim 6 in which said web of hydrophilic fibers contains at least 5% of thermoplastic fibers and in which the panels are joined together at their edges through at least a major portion of the periphery of said dressing by a bond extending through said fiber web, the fibers of said web and the sponge panels in a substantial portion of said bond being compressed and the thermoplastic fibers fused.

8. A dressing of claim 7 in which said bond by heat and pressure extends completely around the entire periphery of said sponge.

9. A dressing of claim 8 in which one surface of the dressing is substantially in the same plane as the edge of said dressing.

10. A dressing of claim 7 in which a portion of the seal around the periphery of the dressing is formed by an adhesive strip inserted between the panels.

11. A dressing comprising
a first sheet of cellular sponge material, a web of hydrophilic fibers bonded to said first sheet of cellular sponge material by fiber bundles containing capillary channels therein extending from said web of fibers through said first sheet of cellular sponge material to the opposite side thereof, the ends of said fiber bundles forming on the surface of said first sheet of cellular sponge on the side opposite to that containing said fiber web fluid-absorbing areas,
a second sheet of cellular sponge material, a web of hydrophilic fibers bonded to said second sheet of cellular sponge material by fiber bundles containing capillary channels therein extending from said web of fibers through said second sheet of cellular sponge material to the opposite side thereof, the ends of said fiber bundles forming on the surface of said second sheet of cellular sponge on the side opposite to that containing said fiber web fluid-absorbing areas,
said first and second sheets of cellular sponge material being superimposed one on top of the other with their surfaces containing said fiber webs contained between said sheets of cellular sponge material and their surfaces containing the fiber bundle ends forming the outer surface of said dressing,
said first and second sheets of cellular sponge material being secured to each other around the edges thereof to seal the fibers forming said fiber webs inside of said sponge sheets, said sheets of sponge material having a flexibility of 17 to 74%, a resiliency of 78 to 98% and a pore size of 25 to 100 per linear inch.

12. A dressing of claim 11 in which said first and second sheets are formed of a single sheet of cellular sponge material with said fiber web laminated thereto, said sheet being folded on itself to form said first and second sheets, and said first and second sheets being secured together around the edges thereof not containing said fold by bonding together the cellular sponge sheet surfaces, the bond between said cellular sponge sheet surfaces being contained within said dressing.

13. A dressing of claim 11 in which said first and second sheets are formed of a single sheet of cellular sponge material with said fiber web laminated thereto, said sheet being folded on itself to form said first and second sheets, and said first and second sheets being secured together around the edges thereof not containing said fold by bonding through said fiber web.

14. A dressing of claim 11 containing an absorbent pad disposed between said fiber webs, the edges of said absorbent pad terminating short of the inner bonded edges of said dressing.

15. A dressing of claim 11 in which the major proportion of said fibers are rayon fibers having a length of ½ to 3 inches and a denier of 1 to 6.

16. A dressing of claim 15 in which said fibers are a mixture of rayon fibers and thermoplastic fibers, the thermoplastic fibers being present in amounts of at least 5%.

17. A dressing of claim 16 in which at least a portion of said edges are sealed together by heat and pressure through said fiber web.

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