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**80210**  
 [21] Appl. No. **871,074**  
 [22] Filed **Oct. 9, 1969**  
 Division of Ser. No. 744,248, June 24, 1968,  
 which is a continuation-in-part of  
 Ser. No. 477,851, Aug. 6, 1965  
 [45] Patented **Aug. 3, 1971**

*Primary Examiner*—Dorsey Newton  
*Attorney*—Fraser and Bogucki

**ABSTRACT:** A catamenial tampon is disclosed having rapid initial and high total moisture absorptivities. The tampon is generally cylindrical and has a blunt forward end provided with a forwardly facing, diverging cavity for physically trapping and pooling menstrual fluid. The cavity, which may be in the form of a V-shaped notch, has a width across the forward extremity at least about one quarter of the overall diameter of the tampon. The portions of the tampon defining the cavity are flexible and resilient so that they may be pressed toward one another to facilitate insertion and removal of the tampon. Further, these portions expand forwardly and outwardly during menstrual fluid absorption thereby exposing more internal surface area of the tampon to enhance further absorption of fluid and block egress of the trapped fluid.

Methods for making the foregoing catamenial tampon are also disclosed. Generally, the tampon is made by providing a strip of cellulosic cotton with a forwardly diverging cavity in the forward end. This may be accomplished by moving a continuous web of cotton material past a cutter device which separates the web into strips having an initial shape and size. Each individual strip is then compressed both radially and longitudinally into a generally cylindrical configuration having the desired final shape and size.

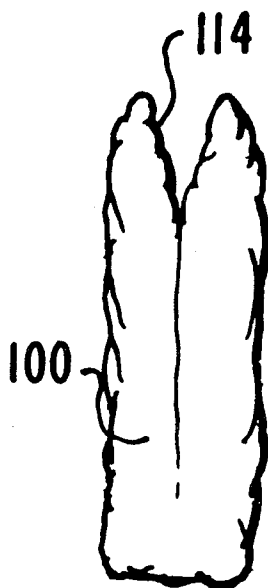
[54] **METHOD OF MAKING CATAMENIAL DEVICES**  
**2 Claims, 44 Drawing Figs.**

[52] U.S. Cl. .... 19/144.5  
 [51] Int. Cl. .... A61I 15/00  
 [50] Field of Search ..... 19/144.5;  
 128/285, 270

[56] **References Cited**

**UNITED STATES PATENTS**

|           |        |                |            |
|-----------|--------|----------------|------------|
| 61,417    | 1/1867 | Grant .....    | 19/144.5 X |
| 2,355,628 | 8/1944 | Calhoun .....  | 128/285    |
| 2,905,175 | 9/1959 | Schwartz ..... | 128/270    |



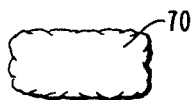


FIG. - 2

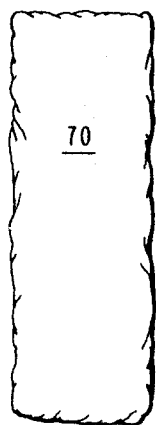


FIG. - 1

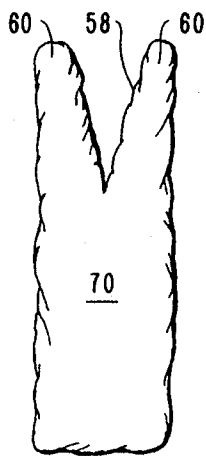


FIG. - 3

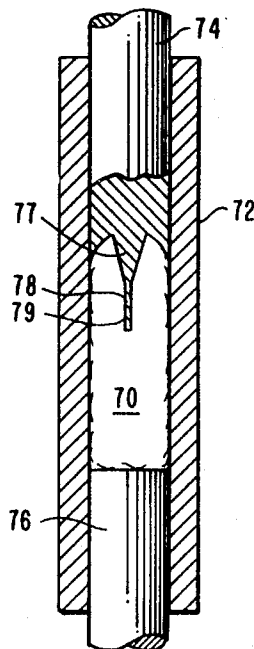


FIG. - 4



FIG. - 6

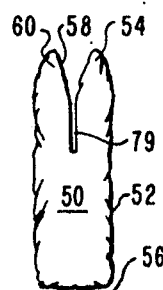


FIG. - 5



FIG. - 15

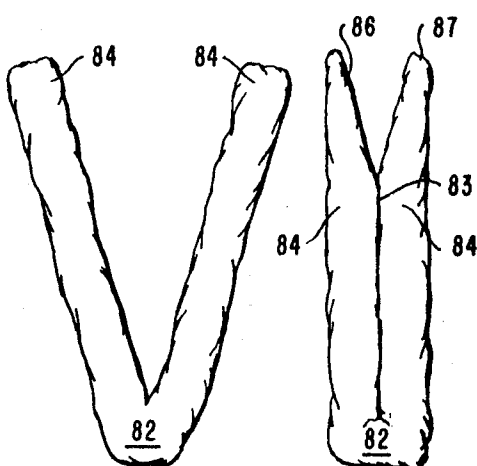


FIG. - 16

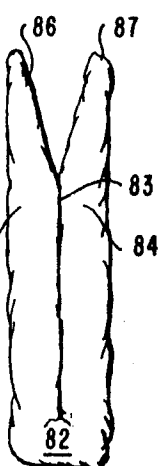


FIG. - 17

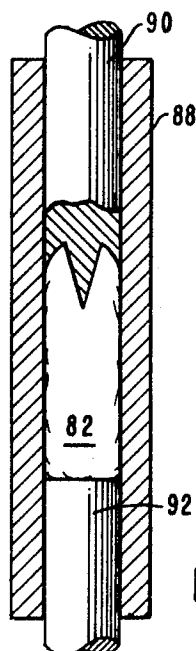


FIG. - 18



FIG. - 20



FIG. - 19

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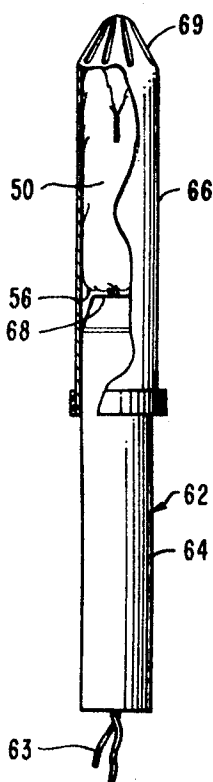


FIG. -7

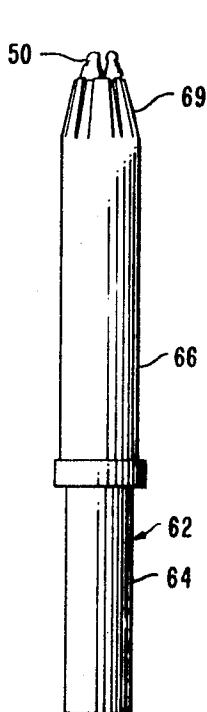


FIG. -8

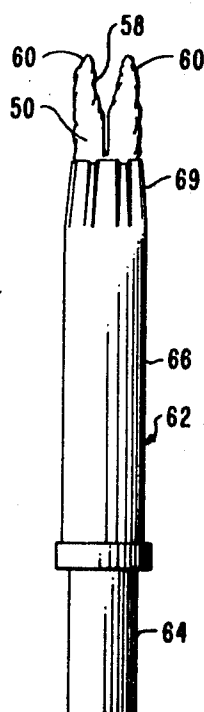


FIG. -9

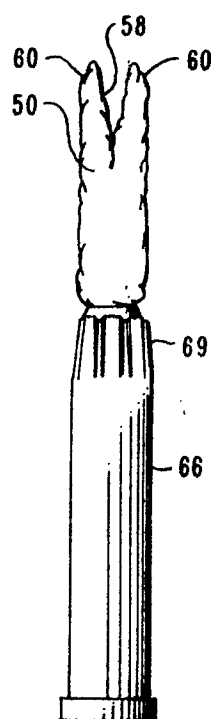


FIG. -10

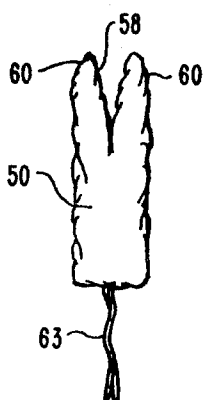


FIG. -11

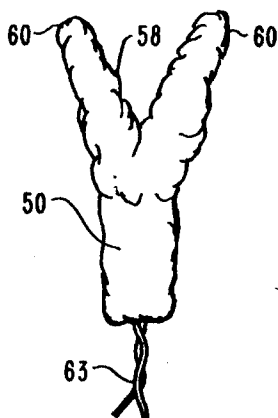


FIG. -12

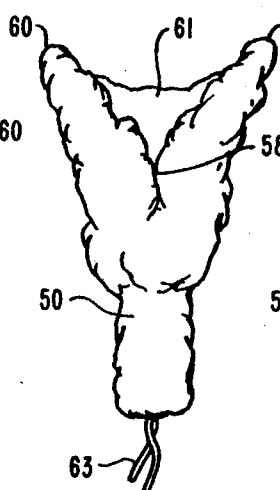


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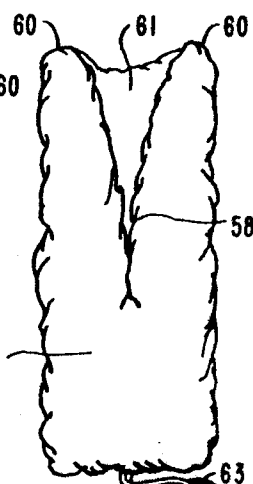


FIG. -14

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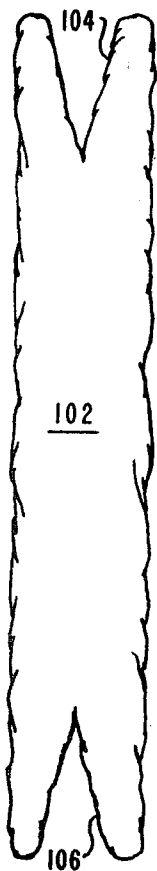


FIG. -21

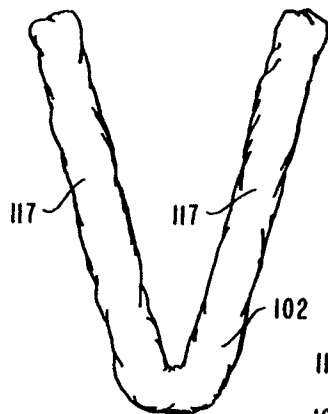


FIG. -22

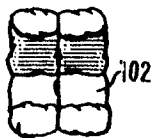


FIG. -23

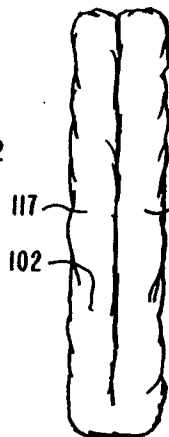


FIG. -24

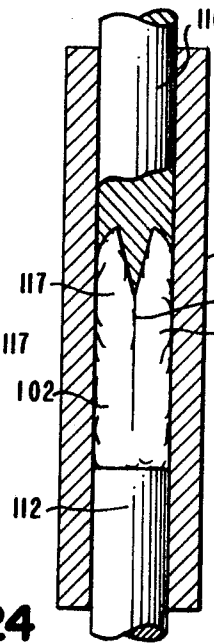


FIG. -25



FIG. -26

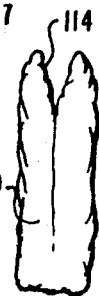


FIG. -27



FIG. -28



FIG. -29

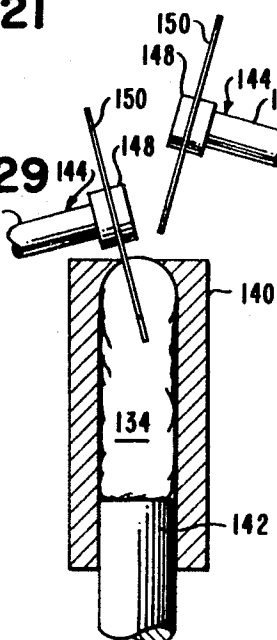


FIG. -30

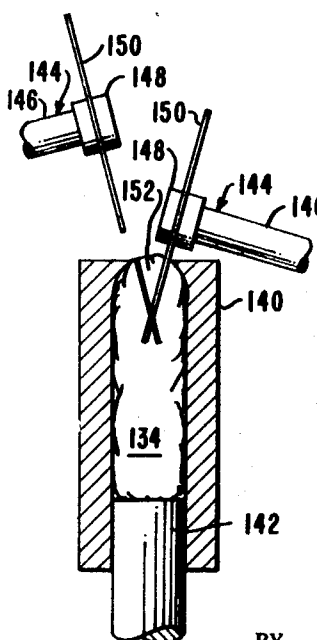


FIG. -31



FIG. -32

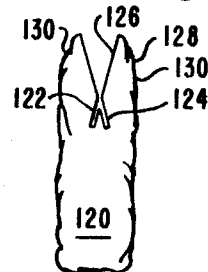


FIG. -33

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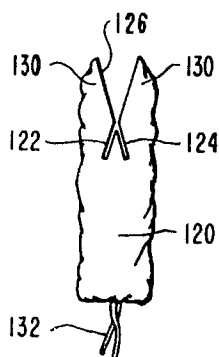


FIG. - 34

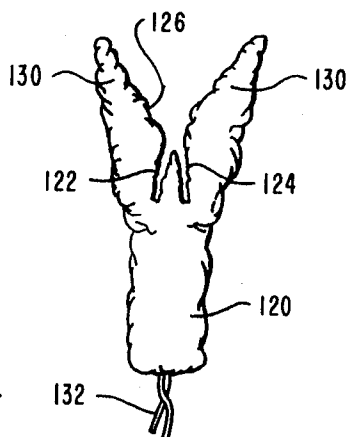


FIG. - 35

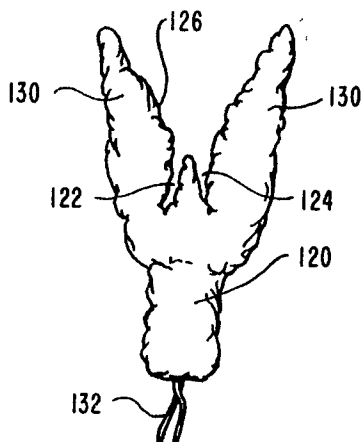


FIG. - 36

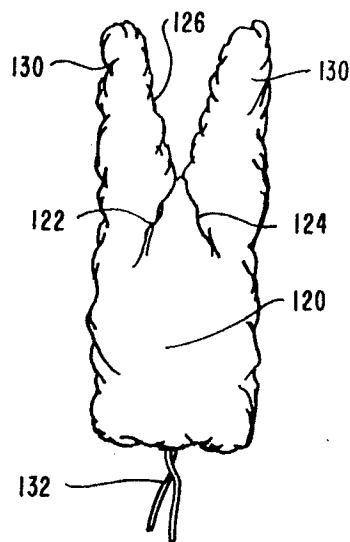


FIG. - 37

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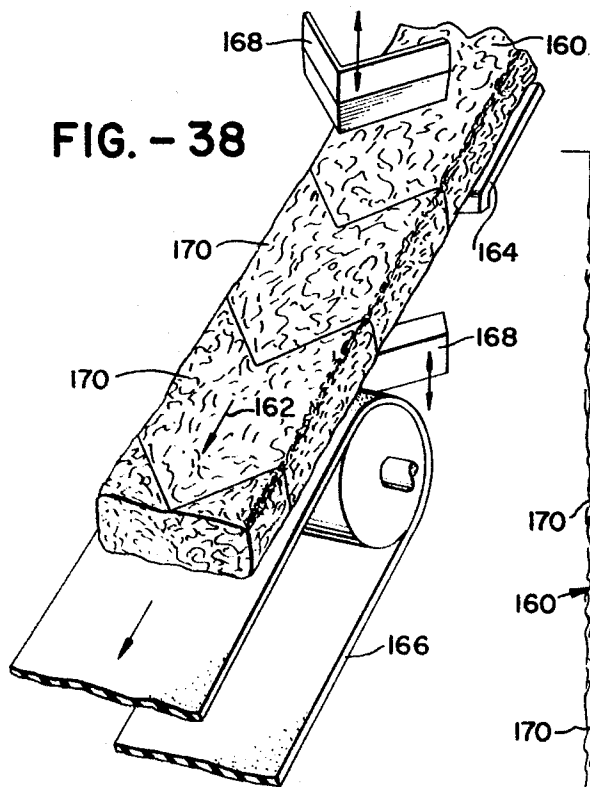


FIG. - 38

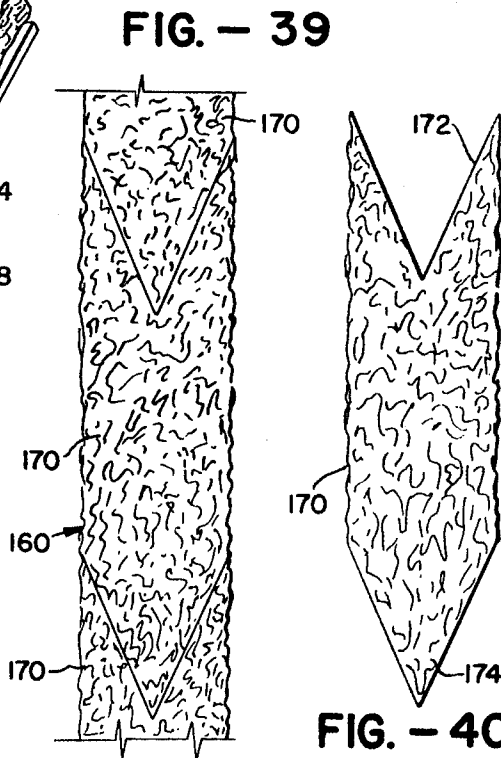


FIG. - 39

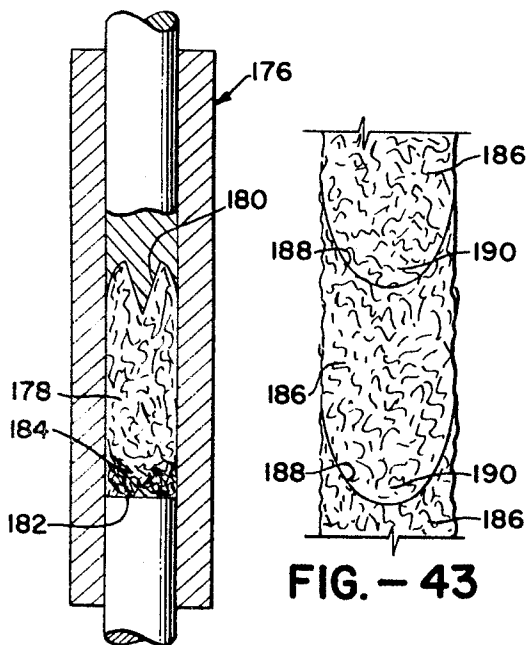


FIG. - 42

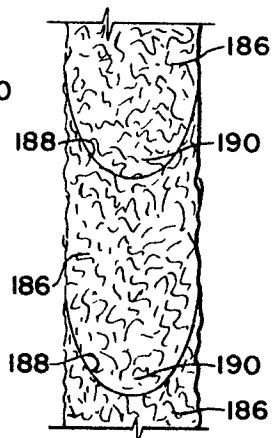


FIG. - 43

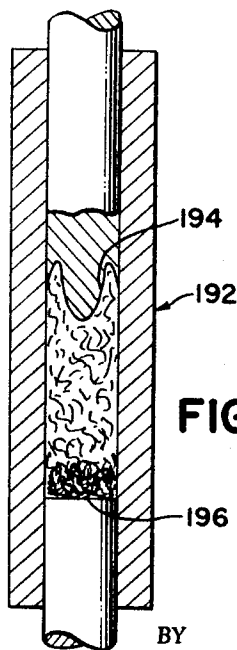


FIG. - 44



FIG. - 41

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## METHOD OF MAKING CATAMENIAL DEVICES

This application is a divisional of application Ser. No. 744,248, filed June 24, 1968 which is a continuation-in-part of application Ser. No. 477,851, filed Aug. 6, 1965 by Joseph A. Voss and entitled "Catamenial Devices and Methods of Making the Same."

## BACKGROUND OF THE INVENTION

The present invention generally relates to catamenial devices and more particularly relates to improved catamenial tampons and methods of making the same.

Catamenial tampons are increasing in popularity, particularly because of their relatively small size, and their improved portability and concealability in contrast to sanitary napkins. For example, tampons can be utilized for various sports activities and do not require auxiliary devices such as a sanitary napkin belts. Moreover, an emergency supply of the tampons can be carried readily in the purse or can be concealed readily on the person.

However, a recognized major deficiency of conventional catamenial tampons is their inability to cope with rapid and/or menstrual fluid rapidly so that they are unable to prevent menstrual fluid leakage under such circumstances. Moreover, they usually do not have a very large total absorptivity. Accordingly, it is necessary to change tampons frequently, especially during the first few days of a normal menstrual period when the flow is relatively large. In addition, many of the conventional tampons are relatively difficult and/or painful to insert into a correct position in the vagina.

Most conventional tampons comprise cellulosic material which has been greatly compressed to reduce the tampon to a conventional size. However, such high compression of the cellulosic material results in lowered absorptivity per unit weight of the tampon and also makes the material hard, thus increasing chances of irritation of delicate vaginal tissues during insertion of the tampon.

Attempts to increase the moisture absorptivity of the cellulosic material by coating the outside thereof with silicones and the like have been only partially effective. In many instances, the exterior of conventional tampons reaches the moisture saturation point and is no longer able to trap and retain menstrual fluid at a time when a substantial portion of the interior of the tampon is still relatively free of moisture. Leakage of menstrual fluid then occurs around the tampon. Frequently such leakage also occurs because most conventional tampons tend to expand in an irregular fashion during menstrual fluid absorption. Thus, they tend to distend the vagina in such a manner as to leave gaps through which the menstrual fluid leaks. Such distention is particularly noticeable when only a portion of the surface of the tampon is initially wetted by the menstrual fluid. Nonuniform dimensional expansion of conventional tampons is, in part, attributable to the method of manufacture of such tampons and also to the fact that the transfer of moisture between any two spaced points in the tampon is relatively slow, since initial absorptivity is low.

Moreover, most conventional tampons do not incorporate any means for physically trapping menstrual fluid. Instead, their capacity to retain menstrual fluid solely depends on absorption of menstrual fluid within and between the cellulosic fibers. Thus, the usual catamenial tampon is in the form of a blunt-ended plug of relatively smooth cylindrical shape and is fabricated from cotton or rayon or the like which has been highly compressed under, for example, about a 1,000 p.s.i. or more. Typically, the outer portion of such a tampon is much more highly compressed than the interior portion and is smooth, unbroken and much less able to absorb moisture. The net result is that the tampon has a tendency to absorb moisture slowly and unevenly throughout the body thereof, with the outer portion of the tampon acting as an effective barrier against penetration of moisture to the interior of the tampon. The observed deficiencies of conventional tampons have seriously limited their appeal to a considerable segment of the

female population. Attempts to overcome certain of such deficiencies have not met with success, either from a technical or economical standpoint.

Accordingly, it would be desirable to provide a relatively inexpensive, simple catamenial tampon capable of being readily and efficiently inserted and removed from the vagina without discomfort, difficulty or pain and capable of rapidly absorbing and retaining large quantities of menstrual fluid throughout the body of the tampon. It would also be desirable to provide an inexpensive tampon incorporating an efficient physical trap against inadvertent leakage of menstrual fluid from the vagina. Upon contact with moisture, the tampon should expand in a manner which avoids irregular distention of the vagina. The combination of a physical trap and rapid initial and high total moisture absorptivity should permit the tampon to be used effectively over a substantial period of time without danger of leakage of menstrual fluid. The tampon should also be usable with an applicator which facilitates painless insertion of the tampon into the correct portion of the vagina. In addition, it would be desirable if the tampon were adapted for specialty uses, such as insertion of medications and the like.

## SUMMARY OF THE INVENTION

In accordance with one aspect of the present invention, an improved catamenial tampon is provided which includes a substantial cylindrical main body portion and a blunt, generally conical forward end which facilitates insertion of the tampon into the vagina. The forward end incorporates a generally centrally positioned, forwardly diverging, open-ended cavity, the forwardmost end of which has a width at least about one quarter of the diameter of the main body portion and is adapted to physically trap menstrual fluid. The cavity may be V-shaped, U-shaped or the like. The cavity permits immediate contact of the menstrual fluid with a substantial proportion of the interior of the tampon, for substantially uniform moisture absorption by both the interior and exterior of the tampon. The fingers forming the cavity expand forwardly and outwardly during moisture absorption to increase the size of the cavity and to block the vagina very effectively. A further feature of the tampon is the ability of the cavity to act as a container for medication such as medicated salves, ointments and the like for treatment of the vagina. The fingers defining the cavity curve inwardly along their exterior surfaces and are flexible, yet are sufficiently strong to resist lateral and rearward reflection during insertion of the tampon. The resilient fingers can be approximated during ejection of the tampon from an applicator having a generally conically shaped forward end or the like, yet return to their normal open cavity-defining position thereafter. An applicator of the type described above is disclosed in U.S. Pat. No. 3,204,635 issued to Joseph A. Voss and Carl W. Johnson on Sept. 7, 1965.

As a specific example, a catamenial tampon is formed from a strip of cellulosic cotton, approximately 3 inches long, 1 inch wide and one-half inch thick, the majority of fibers of which strip are oriented parallel with the longitudinal axis of the strip. The strip is cut at one end thereof to provide a forwardly diverging, V-shaped, central cavity having a minimum width at the open forward end of about one-half inch and extending rearwardly from the forward end of the tampon for a distance of about 1 inch. According to one method of the present invention, successive strips are cut from a moving, continuous web of cotton material by V-shaped cutter means to form a series of chevron-shaped strips, that is, strips having a V-shaped cavity in the forward end and a V-shaped pointed rear extremity conforming to the configuration of the forward cavity.

Each strip is then placed in a compression zone comprising a male-female die system and is compressed uniformly inwardly both radially and longitudinally to a generally cylindrical form under a pressure of several hundred p.s.i. to a diameter of about seventeen thirty-seconds of an inch and an overall length of approximately 1 7/16 inch. During compression, the

cavity is also decreased in size to a final maximum width of approximately one-fourth inch at the open, forward end thereof. It has a final overall depth of about one-half inch and is symmetrically disposed with respect to the longitudinal axis of the tampon.

The interior surfaces of the fingers defining the cavity are maintained relatively flat so that the cavity is open-sided. However, the forward end of the tampon containing the centrally disposed cavity is formed into a generally conical shape so that the exterior surfaces of the fingers defining the cavity curve inwardly and forwardly, whereby they facilitate insertion of the tampon into the vagina. Upon contact with menstrual fluid the tampon exhibits relatively uniform dimensional expansion due to the ability of the menstrual fluid to contact both the interior and the exterior of the tampon essentially simultaneously via the cavity disposed in the forward end thereof.

### BRIEF DESCRIPTION OF THE DRAWINGS

Further objects and advantages of the present invention will be apparent from a study of the following detailed description and the accompanying drawings, in which:

FIG. 1 is a side elevation view of a strip of cellulosic material from which a first embodiment of the tampon of the present invention is to be formed;

FIG. 2 is a plan view of the strip of FIG. 1;

FIG. 3 is a side elevation view of the strip of FIG. 1 after formation of a cavity in one end thereof;

FIG. 4 is a side elevation view, partly broken away and partly in cross section, of apparatus for compressing the strip of FIG. 3 into its final shape and size;

FIG. 5 is a side elevation view of a first embodiment of the tampon of the invention;

FIG. 6 is a plan view of the tampon of FIG. 5;

FIG. 7 is a side elevation view, partly broken away, illustrating the tampon of FIG. 5 in an applicator before ejection of the tampon;

FIG. 8 is a side elevation view of the tampon of FIG. 5 during initial ejection thereof from the applicator of FIG. 7;

FIG. 9 is a side elevation view of the applicator of FIG. 7 during further ejection of the tampon of FIG. 5 therefrom;

FIG. 10 is a side elevation view illustrating the tampon of FIG. 5 after complete ejection from the applicator of FIG. 7;

FIG. 11 is a side elevation view of the tampon of FIG. 5 during initial contact with moisture, such as menstrual fluid;

FIG. 12 is a side elevation view of the tampon of FIG. 11 during initial expansion as a result of absorption of moisture;

FIG. 13 is a side elevation view of the tampon of FIG. 12 during absorption of further amounts of moisture and illustrating pooling of fluid in the cavity thereof;

FIG. 14 is a side elevation view of the tampon of FIG. 13 after full absorption of moisture;

FIG. 15 is a front elevation view of a strip of cellulosic material utilized in the fabrication of a second embodiment of the tampon of the present invention;

FIG. 16 is a side elevation view of the strip of FIG. 15 after partial folding thereof;

FIG. 17 is a side elevation view of the strip of FIG. 16 after complete folding and after formation of a cavity in the upper end thereof;

FIG. 18 is a side elevation view, partly broken away and partly in cross section, of apparatus for compressing the strip of FIG. 17 into its final shape and size;

FIG. 19 is a side elevation view of a second embodiment of the tampon of the present invention;

FIG. 20 is a plan view of the tampon of FIG. 19;

FIG. 21 is a front elevation view of a strip of cellulosic material utilized in fabricating a third embodiment of the tampon of the present invention, said strip including a notch at each of two opposite ends thereof;

FIG. 22 is a side elevation view of the strip of FIG. 21 after partial folding thereof;

FIG. 23 is a plan view of the strip of FIG. 22 after full folding thereof;

FIG. 24 is a side elevation view of the strip of FIG. 23;

FIG. 25 is a side elevation view, partly broken away and partly in cross section, of apparatus for compressing the strip of FIG. 24 into its final shape and size;

FIG. 26 is a side elevation view of a third embodiment of the tampon of the present invention;

FIG. 27 is a plan view of the tampon of FIG. 26;

FIG. 28 is a side elevation view of a tampon plug prior to formation into a fourth embodiment of the tampon of the present invention;

FIG. 29 is a plan view of the tampon of FIG. 28;

FIG. 30 is a side elevation view, partly broken away and partly in cross section, of apparatus for cutting slits in the conical forward end of the tampon of FIG. 28;

FIG. 31 is a side elevation view, partly broken away and partly in cross section, of the apparatus of FIG. 30 during cutting of a second slit in the conical forward end of the tampon of FIG. 28;

FIG. 32 is a side elevation view of a fourth embodiment of the tampon of the present invention;

FIG. 33 is a plan view of the tampon of FIG. 32;

FIG. 34 is a side elevation view of the tampon of FIG. 32 during initial absorption of moisture;

FIG. 35 is a side elevation view of the tampon of FIG. 34 after initial expansion thereof during further absorption of moisture;

FIG. 36 is a side elevation view of the tampon of FIG. 35 during absorption of still further amounts of moisture;

FIG. 37 is a side elevation view of the tampon of FIG. 36 after absorption of moisture to the limit of absorptivity thereof;

FIG. 38 is a partially schematic perspective view of a portion of an apparatus for cutting chevron-shaped strips from a traveling, continuous web of cellulosic material;

FIG. 39 is a plan view of a portion of the web material of FIG. 38 after the cutting operation and before separation of the web into individual strips;

FIG. 40 is a side elevation view of an individual strip of tampon material formed by the cutting apparatus of FIG. 38;

FIG. 41 is a plan view of the strip of FIG. 40;

FIG. 42 is a side elevation view, partly broken away and partly in cross section, of an apparatus for compressing the chevron-shaped strip of FIG. 40 into final shape and size;

FIG. 43 is a plan view of a portion of a web of cellulosic material after cutting, by means of an apparatus such as that depicted in FIG. 38, into individual tampon strips having an alternative configuration; and,

FIG. 44 is a side elevation view, partly broken away and partly in cross section, of an apparatus for compressing an individual strip, separated from the web shown in FIG. 43, into final shape and size.

Now referring more particularly to FIG. 5 of the accompanying drawings, a first embodiment of the improved tampon, designated generally by the reference numeral 50, is illustrated. As shown in FIG. 5, the tampon 50 comprises a generally cylindrical body 52 of fluid-absorptive, fibrous cellulosic material, such as rayon, cotton or the like, said body having a rounded or generally conically shaped forward end 54 and a generally blunt or squared-off rear end 56. Formed in the forward end 54 of the tampon 50 is a centrally positioned, open-ended cavity or notch 58, in this case having a generally V-shaped configuration, defined by a pair of forwardly diverging fingers 60.

Although the cavity 58 is normally in an open position, as illustrated in FIG. 5, the flexibility of each finger 60 is such that the cavity 58 can be substantially closed, as for example, during ejection of the tampon from an applicator 62, as illustrated in FIGS. 7-10. The applicator 62 may be of the type disclosed in U.S. Pat. No. 3,204,635, already referenced.

As shown in FIG. 7, the tampon 50 is provided with a drawstring 63 of any suitable material, such as two-strand,

twisted cotton string. The drawstring is secured as by sewing or the like to the rear end 56 of the tampon 50. Also, as shown in FIG. 7, the cavity 58 of the tampon 50 before ejection from the applicator 62 is in a substantially open position within the applicator 62. The drawstring 63 extends rearwardly from the applicator 62. Ejection of the tampon 50 from the applicator 62 is achieved by pushing an inner tube or plunger 64 forward relative to an outer portion 66 of the applicator 62, the tampon being disposed in said outer tube portion 66. The forward end 68 of the plunger 64 contacts the rear end 56 of the tampon 50 and expels the tampon 50 from the generally conical forward end 69 of the applicator 62, as shown in FIGS. 8-10. During such ejection, the cavity 58 substantially closes. However, as illustrated in FIGS. 9 and 10, after the forward end 54 of the tampon 50 clears the forward end 69 of the applicator 62, the cavity 58 assumes its normally open position. As the tampon 50 is slid up into the vagina, the vaginal walls may substantially close the cavity 58 but the resiliency of the fingers 60 causes opening of the cavity 58 when in place in the vagina. Thus, the tampon 50 is ready for immediate effective use in physically trapping and absorbing menstrual fluid in the vaginal cavity.

The tampon 50, during menstrual absorption, is illustrated in FIGS. 11-14 of the accompanying drawings. Thus, FIG. 11 illustrates the tampon 50 during initial contact with menstrual fluid. FIGS. 12 and 13 illustrate the tampon 50 during subsequent absorption of menstrual fluid, and FIG. 14 illustrates tampon 50 after saturation. It will be noted that during menstrual fluid absorption the fingers 60 in the forward end of the tampon 50 uniformly expand forwardly and outwardly, expanding the size of the cavity or notch 58. Moreover, the fingers 60 have the effect of physically blocking the passage of menstrual fluid around the tampon 50 and of channeling the menstrual fluid into contact with the interior portion of the tampon 50. Of course, some menstrual fluid contacts the exterior portion of the tampon 50, so that substantially uniform and complete absorption of the menstrual fluid takes place rapidly, both in the exterior and interior of the tampon 50. This assures relatively uniform and rapid dimensional expansion of the tampon 50. As the limit of absorptivity of the tampon 50 is approached, menstrual fluid 61 may accumulate in the cavity 58, as shown in FIGS. 13 and 14. Even after saturation of the tampon 50, as shown in FIG. 14, the tampon 50 is useful as a physical trap, since it continues to impede the flow of menstrual fluid from the vagina, due to the configuration of the tampon, and acts as a receptacle for pooling the menstrual fluid 61 in the cavity 58. Since the tampon 50 is initially generally cylindrical and expands substantially uniformly in a generally cylindrical fashion, the vagina is not substantially distorted by the tampon 50 during absorption of menstrual fluid, and gaps are not formed in the vaginal cavity around which or through which menstrual fluid can channel to bypass the tampon 50 and leak from the vagina. Instead, the tampon 50 continues to act as an effective physical barrier against flow of menstrual fluid from the vagina, even after saturation of the tampon.

The improved tampon of the present invention may be shaped into final configuration by forming and compressing fibrous, cellulosic material into a generally cylindrical, shape-retaining form having a generally conical forward end defining a forwardly diverging, generally centrally positioned, open-ended cavity. The method can be carried out in any suitable manner. For example, as shown in FIGS. 1-4, the tampon 50 can be formed from a single strip 70 of fibrous cellulosic material. The majority of the fibers are preferably oriented generally parallel with the longitudinal axis of the strip in order to maximize strength of the tampon, resistance to fraying and controlled expansion during moisture absorption. Cotton, rayon and similar cellulosic materials can be used. Rayon has the advantage of being less expensive than cotton and has more uniform fibers. Continuous fiber rayon is available for use in the preparation of the tampon. However, if desired, the tampon can be fabricated from cotton, preferably long-fibered cotton. Other cellulosic products are also contemplated.

Referring again to FIG. 1, the strip 70 can be of any suitable size and shape, for example, rectangular, as illustrated in FIG. 2. Alternatively, the strip may be round in cross section, square, and so forth. In a typical tampon-forming operation, the strip 70 may initially, for example, be about 3 inches long, 1 inch wide and one-half inch thick. In the embodiment of the method of the present invention illustrated in FIGS. 1-4, the cavity 58 is first formed in one end of the strip 70 by any suitable means, for example, a knife or cutter blade, a saw blade or the like (not shown), after which the strip 70 is compressed and finally shaped into the tampon 50. It has been found that the front end of the cavity or notch 58 should have a minimum width at least about one-quarter the diameter of the main body 52 of the tampon 50. Thus, it should extend across at least one-quarter and preferably about one-half of the front of the finished tampon 50 in order to allow adequate access of menstrual fluid into the interior of the tampon and in order to provide fingers sufficiently separated so as to readily expand radially outwardly during absorption of menstrual fluid for the described improved blocking and trapping effects. It will be noted that the cavity 58 is open sided. Moreover, the cavity should extend rearward of the tampon for a sufficient distance to act as an adequate reservoir for the menstrual fluid and expose an adequate portion of the interior of the tampon to the menstrual fluid. Moreover, the fingers defining the cavity 58 should be sufficiently long and thin so as to be flexible for the previously described, temporary closing of the cavity during ejection of the tampon from the applicator 62. Under most circumstances it has been found that the cavity 58 should extend to a depth at least about equal to the maximum width thereof and preferably should be provided with the steadily diverging configuration illustrated in FIGS. 1-5. The cavity 58 is substantially symmetrically disposed with respect to the longitudinal axis of the strip 70.

It should be noted that, if desired, a thin layer of gauze (not shown) can be disposed around the outer surface of the strip 70 before compression. This is particularly desired if long-fibered, nonfraying cellulosic material is not used for the strip 70. In most instances the gauze layer aids in preventing fraying of the outer surface of the tampon 50 in use and also prevents sticking thereof to the walls of the vagina, particularly when the vagina is dry. In the case of rayon, it has been found that gauze is particularly desirable. The gauze can be very thin, soft, absorbent and porous, for example, 1/8-inch mesh. The gauze should not be disposed on the surfaces defining the cavity 58 so as to avoid interference with radial expansion of the fingers 60. It will be understood that the gauze also can be used, if desired, with the tampons described hereinafter.

Before final shaping, the fingers 60 defining the cavity 58 may have relatively parallel exterior portions, but as shown in FIG. 4, when the strip 70 is subjected to final forming and compression, the fingers 60 are shaped such that their exterior surfaces curve forwardly and inwardly to collectively provide the generally conical forward end 54 of the tampon 50. The compression is carried out, as shown in FIG. 4, in a die system comprising a hollow tubular female member 72, an upper cavity-shaping male member 74, and a lower, stationary male support member 76, fabricated of any suitable material such as stainless steel. It will be understood that other suitable equipment can be used, if desired. The upper male member 74 is movable and has a head 77 which is provided with a central, depending blade 78 which provides a recess 79 in strip 70 to a depth of about one-quarter inch below the cavity 58. The recess 79 facilitates radial expansion of the fingers 60 during moisture absorption. The head 77 is shaped to keep the interior surfaces of the fingers 60 relatively flat while the exterior surfaces thereof are being configured to generally conical form. However, it will be understood that, if desired, the interior surfaces can be formed to any other configuration, for example, concave or the like to facilitate cupping of menstrual fluid. The head 77 in such instance would be suitably shaped to impart such configuration to the cavity 58. The female tubular member 72 is either gradually tapering in diameter (not shown) or movable radially inwardly in any suitable manner to provide the required transverse compression.

The dies 72, 74, and 76 are preferably generally cylindrical in horizontal cross section. In the die system illustrated in FIG. 4, the strip 70 preferably is reduced in overall length and diameter to a substantial extent. Thus, the strip 70 may be reduced, for example, to about 50 percent original dimensions under any suitable pressure, for example, a few to several hundred or more p.s.i., to provide a tampon of conventional size, for example, about seventeen thirty-seconds inch in diameter and about 1½ inch to 1¾ inch long. Preferably, the extent of reduction in diameter is proportional to the extent of reduction in length. Moreover, the strip 70 is preferably maintained in untwisted condition during compression so that the tampon 50 will not twist during expansion upon moisture absorption.

The upper end of the die 76 in contact with the lower end of the strip 70 may be flat or the like to give the lower end of the tampon 50 its final configuration during compression. The male die 74 is vertically reciprocated for longitudinal compression of the strip 70 and the die may also be vertically reciprocated or may be stationary, as previously described.

Preferably, compression takes place in the die system of FIG. 4 when the strip 70 has a suitable amount of moisture so as to avoid damage to the cellulosic fibers of the strip. A suitable amount of moisture is present in the strip 70 when it can be detected when the strip is held against the skin, for example, the cheek of the tester. It is also preferred to carry out the compression of the strip 70 at a high enough temperature to "steam press" the strip 70, for example, about 210°–220° F. for cotton and a somewhat lower temperature for rayon. Thus, one or more of the dies may be heated. Such compression may be carried out at any suitable level, for example, several hundred p.s.i. or the like up to 1,000 p.s.i. or more and over a sufficient length of time, depending upon the particular fabrication technique, manual or automatic, to assure substantial retention by the tampon 50 of its compressed size and shape. As an example, compression of the strip 70 at up to 500 p.s.i. over a period of, for example, one-half to 1½ seconds, can be practiced with success. If "cold" compression is utilized, after compression, the tampon is held in a heating-setting unit for 20–30 seconds to provide the final tampon with the appropriate configuration and density.

The final configuration of the tampon 50 is shown in FIGS. 5 and 6. As a specific example, tampon 50 is generally cylindrical with a flat rear end, a final length of 1½ inch and a final diameter of seventeen thirty-seconds inch and is provided with the forward generally conical end 54 extending over about one-quarter of its length. The cavity 58 is centrally aligned in the end 54 and has a minimum width at its front end of about one-quarter inch and a depth of about one-half inch. The recess 79 extends about one-quarter inch rearward of the cavity 58 and is centrally aligned. The fingers 60 are resilient, maintain the cavity 58 normally open and resist lateral rearward reflection during insertion of the tampon 50 into the vagina. However, the fingers 60 readily expand forwardly and outwardly from the body 52 of the tampon 50 during moisture absorption, as previously described.

Accordingly, an improved finished tampon 50 is provided which features uniform expansion during moisture absorption and the physical liquid trap comprising the cavity 58 and the fingers 60, as shown in FIGS. 11–14 of the accompanying drawings. The tampon 50 is very easily, simply and inexpensively fabricated, as indicated in FIGS. 1–4, from any suitable fibrous, cellulosic material.

A second embodiment of the tampon of the present invention is illustrated in FIGS. 19 and 20. In this regard, a tampon 80 is shown in FIG. 19 which is substantially identical in form and shape to tampon 50 of FIG. 5, except that it does not contain a recess, such as recess 79 of the tampon 50. No such recess is necessary, inasmuch as the tampon 80 is formed, as shown in FIGS. 15–18, from a long, thin strip 82 of fibrous cellulosic material folded in half. The junction line 83 between the two limbs 84 of the strip 82, when those two limbs are butted together, can serve the same purpose as a recess in facilitating fanning out of the cavity 86 in the tampon 80 during moisture absorption.

As shown in FIGS. 15–18, the tampon 80 is fabricated in accordance with the present method, but utilizing a slightly different technique from that previously described for the tampon 50. In this regard, the long, narrow strip 82 of fibrous cellulosic material is folded in half so that the two limbs 84 abut, after which the cavity 86 is provided in the forward end 87 thereof as by cutting with a saw blade or the like, as previously described for the tampon 50.

The tampon 80 is then compressed into the final form illustrated in FIG. 19 in any suitable compression means, such as that illustrated in FIG. 18. The compression means illustrated in FIG. 18 is substantially identical to that illustrated in FIG. 4 of the accompanying drawings, except for the absence of the blade 78. For example, a hollow tubular female die 88 similar to the die 72 is provided, preferably of generally circular cross section, along with a vertically reciprocating, mating top male die 90 and a stationary or vertically reciprocating lower die component 92. The male die 90 may be substantially similar to the male die 74 of FIG. 4 and the male die 92 may be substantially similar to the male die 76 of FIG. 4.

The compression of the strip 82 to form the tampon 80 can take place in any suitable manner so as to substantially reduce the size of the tampon during the compression and to finally shape the tampon into the desired shape-retaining configuration illustrated in FIG. 19. Thus, as previously indicated in connection with the die system of FIG. 4, the compression can take place with heated or unheated dies. Preferably "steam pressing" is carried out on the strip 82 in the manner described for the compression and formation of the tampon 50. The tampon 80, of final configuration substantially identical to the tampon 50, functions similarly to the tampon 50. At the junction line 83, the limbs 84 of the tampon 80 below the end of the cavity are suitably joined together so that the tampon 80 is unitary.

The cavity 86 of tampon 80, as shown in FIG. 19, may be used as a container for salve, ointment or other solid or semisolid medication 93. For example, an antibiotic can be disposed in a liquefiable, inert ointment base, such as petrolatum, low-temperature wax or the like, for liquefaction of the base at body temperature and release from the cavity 86 after insertion of the tampon into the vagina. It will be understood that other germicides, acidity control substances, and so forth, can also be used with equal facility in the described manner. The tampon 80 functions substantially as the tampon 50, as shown in FIGS. 11–14, during absorption of menstrual fluid in the vagina.

A third embodiment of the tampon of the present invention is illustrated in FIGS. 26 and 27. In FIG. 26, an improved tampon 100 is shown which is of substantially identical configuration to the tampon 80 of FIG. 19. However, as illustrated in FIGS. 21–25, the tampon 100 is fabricated in accordance with the present method but in a slightly different manner from the tampon 80. In this regard, the tampon 100 is fabricated from a generally flat, longitudinally extending strip of fibrous, cellulosic material 102 illustrated in FIG. 21. A cavity or notch 104 is formed in one end of the strip 102 in the manner described for the strip 70 and a substantially identical cavity or notch 106 is formed in the opposite end thereof, both cavity 104 and cavity 106 being generally centrally disposed, open ended and diverging toward the adjacent end of the strip 102, as shown in FIG. 21. As shown in FIG. 22, the strip 102 is then folded in half so that the cavities 104 and 106 approximate each other and are aligned with each other. The fully folded state for the strip 102 is shown in FIG. 24.

The strip 102 is then placed in a suitable compression means, such as that illustrated in FIG. 25 and subjected to final forming and compression to provide the finished tampon 102. The compression means illustrated in FIG. 25 is substantially identical with that of FIG. 18 and includes a female die 108 comparable to die 88 and male dies 110 and 112, comparable to male dies 90 and 92, respectively, of FIG. 18. Within the compression means illustrated in FIG. 25, the strip 102 is suitably reduced in size and shape, as previously

described for the forming operations schematically illustrated in FIGS. 4 and 18. The notches 104 and 106 are joined together to form a composite cavity 114. Moreover, at the junction line 116 the two limbs 117 of the strip 102 are suitably joined together to form the tampon 100 into a unitary structure. Thus, the finished tampon 100 is substantially identical in configuration and function to the tampon 80.

A fourth embodiment of the tampon of the present invention is illustrated in FIGS. 32 and 33. In FIG. 32, a tampon 120 is shown which is substantially identical to the tampon 50 except that, in place of the recess 79 of the tampon 50, the tampon 120 contains twin, rearwardly diverging recesses 122 and 124 joined at the rear end of a cavity 126 disposed in the forward end 128 of the tampon 120. The recesses 122 and 124 have the same function as that described for the recesses 79, that is, they facilitate forward and outward extension of fingers 130 from the tampon 120 during moisture absorption.

The tampon 120 can be formed in any suitable manner by the present method. One typical technique of formation is illustrated in FIGS. 28—31. Thus, a compressed, generally cylindrical plug 134 of fibrous, cellulosic material having a generally conical forward end 136 and a flat rear end 138 is shown in FIG. 28. This plug 134 is formed in any suitable manner (not shown), for example, by suitable dies, to a finished, shape-retaining form and conventional tampon size. The plug 134 is, as shown in FIGS. 30 and 31, placed within a female die 140 and is supported upon a male die 142 while the upper conical forward end 136 of the plug 134 is left exposed to the action of a pair of cutters 144. Each cutter 144 includes a shaft 146 and a ring 148, bearing a thin cutter blade 150, is secured to one end of the shaft 146. Each cutter blade 150 rotates rapidly by rotation of the shaft 146. As shown in FIG. 30, one cutter blade 150 is passed down into the end 136 at an angle until a recess is formed which extends across the midline or longitudinal axis of the plug 134. The one blade 150 is then withdrawn and a similar recess is formed by the other cutter blade 150, as shown in FIG. 31. A piece 152 of the end 136, defined by the described cuts, is then removed so that the finished tampon 120, having the recesses 122 and 124 and a V-shaped cavity 126 formed therein, is provided. The tampon 120, as previously described has the general configuration of tampon 50 and the advantages thereof. Alternatively, the tampon 134 may be provided with a V-shaped cavity in the manner described, prior to compression. It has been found that this results in a lower density of the fingers 130 and thereby enhances the initial moisture absorbing capabilities of the tampon.

The tampon 120 is shown in FIG. 34 after installation of a suitable drawstring 132 at the rear end thereof (as by sewing, etc.) and before contact with liquid moisture, such as menstrual fluid. In FIG. 35, the tampon 120 is illustrated after initial contact with menstrual fluid and during initial expansion. It will be noted that the fingers 130 have expanded in size and have moved in a forward and outwardly diverging direction, with respect to the tampon 120. The presence of the recesses 122 and 124 facilitates this divergence. Rapid divergence is highly desirable in facilitating the rapid sealing-off of the vagina from menstrual flow. Moreover, the recesses 122 and 124 somewhat increase the total surface area and volume of the cavity 126, thereby facilitating rapid absorption of menstrual fluid by the interior of the tampon. Accordingly, the recesses 122 and 124 aid in physically trapping and pooling the menstrual fluid, sealing off the vaginal area against leakage, and rapidly and uniformly absorbing menstrual fluid. In FIG. 26, the tampon 120 is illustrated after further absorption of menstrual fluid, and in FIG. 37 the tampon 120 is illustrated after saturation with menstrual fluid. Accordingly, the tampon 120 is very similar in function to the tampon 50.

Accordingly, an improved catamenial tampon is provided having a generally conically shaped forward end, a generally cylindrical main body and a centrally positioned, forwardly diverging, normally open cavity having a width at its forward end at least about one-quarter of the diameter of the body.

The fingers forming the cavity have curved exterior surfaces, are flexible and resilient, yet strong enough to resist lateral rearward deflection during insertion of the tampon. The fingers expand forwardly and laterally during absorption of menstrual fluid, so as to effectively block the vagina and so as to channel menstrual fluid to the tampon cavity. The shape of the tampon cavity controls the direction of expansion of the fingers. Moreover, the tampon cavity provides access to the interior of the tampon so that all parts of the tampon can be used for absorption of menstrual fluid. One or more recesses may be located to the rear of the tampon cavity to further facilitate the desired directional guidance of the fingers during expansion of the tampon.

It will be noted that the tampon cavity can be used as a container for excess menstrual fluid. In addition, the cavity can be used as a container and dispenser for any suitable medicament in semisolid or solid form which it is desired to deliver to the vagina via the tampon. Accordingly, the cavity has several important functions which improve the results obtained through the use of the tampon. Thus, the tampon effectively protects for a long period of time against leakage of menstrual fluid from the vagina. In this regard, the tampon features rapid initial moisture absorption and high total moisture absorption, in contrast to conventional tampons.

Referring now to FIGS. 38—42, an alternative fabrication technique is depicted for making tampons in accordance with the present invention. A continuous web 160, comprising the cellulosic material from which the tampons are to be fashioned, is moved longitudinally, at a predetermined velocity and in a direction indicated by the arrow 162, along a platen 164, by means of an endless belt 166 suitably driven by means not shown. The web 160 moves between a pair of opposed, vertically aligned cutter blades 168 mounted to reciprocate vertically into periodic engagement with one another in timed relation with the movement of the web 160. In this way, the web is severed into a series of strips 170 of substantially identical shape and size.

In the example of FIGS. 38—41, the cutters are provided with a V-shape. As shown in FIGS. 40 and 41, each individual strip 170 formed by the apparatus of FIG. 38 has a chevron shaped with a V-shaped notch 172 at one end (the forward end) and a projecting, V-shaped point 174 at the other end (the rear end). The chief advantage of this fabrication technique is that there is no waste in the raw material used to form the tampons as there is, for example, in the embodiment of FIGS. 30—33 in which the piece 152 is discarded.

After separation from the web 160, each individual strip 170 is compressed, in both the transverse and the longitudinal directions, in a die apparatus 176 shown in FIG. 42 and which operates in a fashion already described. The final shape of the compressed tampon 178 is like that shown in FIG. 19, for example, in which the rounded or generally conical forward end is provided with an open-sided, V-shaped notch 180 and the rear end 182 is flattened and disposed substantially perpendicular to the longitudinal axis.

It will be appreciated that when the tampon is compressed into its final shape, and the rear end flattened, the rear portion 184 of the tampon will be somewhat more dense than the forward portion as a result of the compression of the material forming the V-shaped point 174 into the main body of the final tampon. It has been found, however, that the increased density of the rear extremity does not impair the fluid-absorbing qualities or capacity of the tampon.

It will be evident that the forwardly diverging cavity of the tampon may take other shapes. Thus, for example, as illustrated in FIG. 43, the web may be cut by the mechanism of FIG. 38 into strips 186 having rounded, instead of V-shaped cavities and rear ends, 188 and 190, respectively. Likewise, the compression of such strip may be done by apparatus 192, shown in FIG. 44, which provides a generally U-shaped, forwardly diverging cavity 194 and a blunt rear extremity 196.

Various changes, modifications, alterations and additions can be made in the present method, the steps of method, and

the materials, equipment and parameters for carrying out the method and in the improved tampon produced by the method. All such changes, alterations, modifications and additions as are within the scope of the appended claims form a part of the present application.

What I claim is:

1. A method of making an improved catamenial tampon, which method comprises folding an elongated, fibrous, cellulosic strip upon itself to provide a pair of limbs permanently connected at the rear end thereof; forming complementary, forwardly diverging cavities in the front ends of said limbs; and shaping and compressing said limbs to bond said limbs together along the length thereof and form said limbs into a generally cylindrical main body and an integral, generally conical forward end, the cavities of said limbs together defin-

ing in said forward end a centrally disposed, forwardly diverging cavity having an open front end with a width across said front end at least one-quarter the transverse diameter of said main body.

2. A method of fabricating tampons, each tampon having a forwardly diverging cavity in the front end and a blunt rear end, comprising the steps of feeding a continuous web of cellulosic material in a longitudinal direction; successively severing strips from said web by cutting said web transversely to form a rearwardly directed projection and a mating, forwardly directed cavity in successive strips; and compressing said strips in succession both longitudinally and transversely and simultaneously shaping said strip into the final tampon configuration.

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