Dec. 10, 1957 G. C. GRAHAM, JR 2,815,756

FLEXIBLE PRODUCT

Filed Oct. 12, 1955

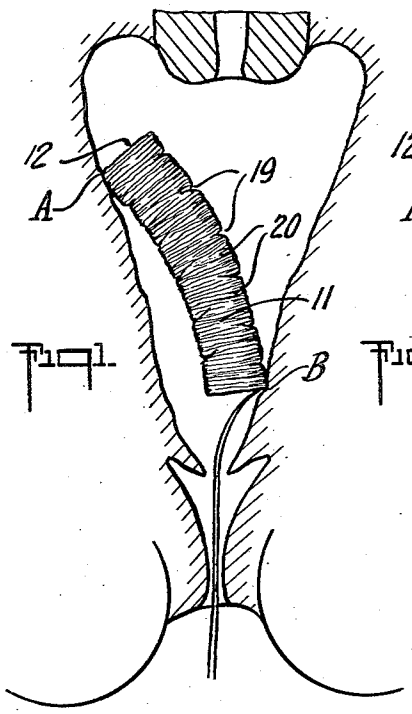

Fig. 1.

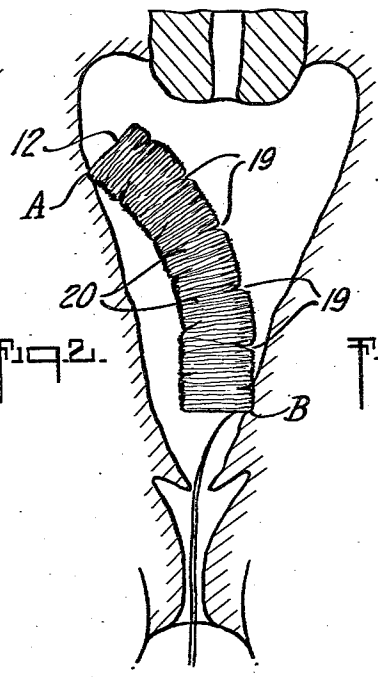

Fig. 2.

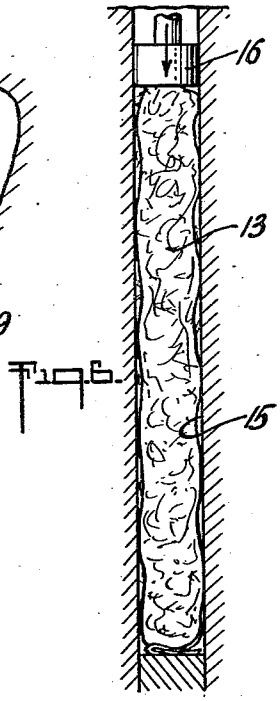

Fig. 6.

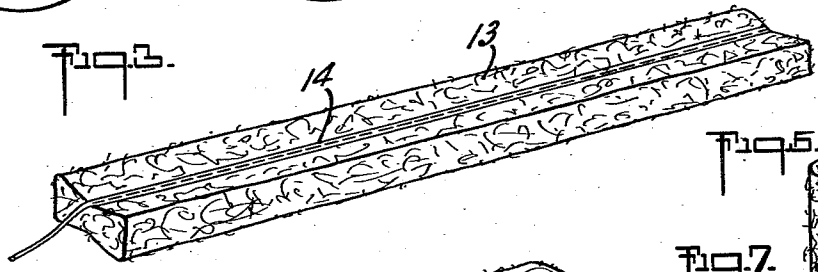

Fig. 3.

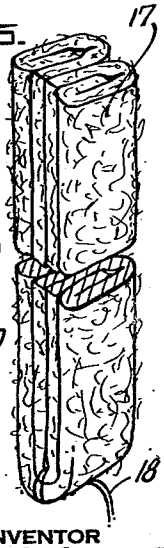

Fig. 5.

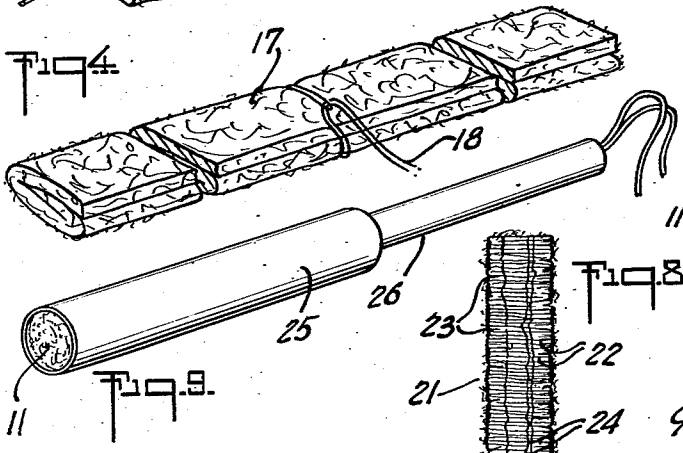

Fig. 4.

Fig. 7.

Fig. 9.

Fig. 8.

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2,815,756

FLEXIBLE PRODUCT

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Application October 12, 1955, Serial No. 540,121

13 Claims. (Cl. 128—285)

The present invention relates to absorbent catamenial tampons and more particularly to compressed cylindrical tampons such as can be put in place in the vagina by a plunger-type inserting device.

These tampons are positioned in the vagina to absorb menstrual fluid and prevent its flow through the vaginal orifice. It has been the practice to compress a web of cotton into a relatively stiff cylindrical tampon which can be placed in a cardboard tube having a plunger which may be operated to eject the tampon from the tube. The tube can be inserted in the vaginal cavity and the plunger operated to position the tampon in the vagina, as it is removed from the tube.

It has been found, as a practical matter, that compressed tampons of this type must be limited in size with respect to the female organs due to considerations of comfort during use and ease of insertion and retraction. The vaginal cavity is collapsed by the pressure of the bodily parts above and below it, such that the upper and lower vaginal walls are very close to and partly in contact with one another except where they are held apart by the tampon and the vagina increases in width from the vaginal orifice to the cervix to provide a flat pear-shaped cavity which is considerably wider than the vaginal orifice itself. Since a considerable portion of the weight of the torso tends to collapse the vagina, it has been found that tampon size must be kept to a minimum consistent with absorptive capacity to prevent discomfort to the user particularly as the tampon expands with the absorption of menstrual fluid. Also, the original diameter of the tampon must be kept small enough to allow easy retraction after it has expanded through absorption. In this connection, the most practical tampon size has been found to be slightly less than two inches in length and about one-half of an inch in diameter. Of course, these dimensions may be varied to some extent and either increased or decreased slightly to suit the size of the user. In fact, in present commercial practice, they are quite commonly sold in three sizes, junior, regular, and super, of approximately seven-sixteenths, one-half and five-eighths of an inch in diameter, from about one-and-one-half to about two inches long and weighing from about twenty to about sixty grains. Tampons in this size range are considerably smaller than would be necessary to completely fill the vaginal cavity. Although tampons within the lower weight ranges are commercially available, most of the tampons used weigh at least about thirty-five grains.

As mentioned above, the lower limits of size are controlled to a great extent by absorptive capacity, which in turn is a function of the amount or weight of absorptive material in the tampon. Thus, for a given size tampon, absorptive capacity is a function of the amount of absorptive material which can be compressed into the tampon, or its density. Generally speaking, if the density of a tampon is increased by methods known in the art, its stiffness and ragidity will also increase. Thus, prior art tampons, within the practical size limits mentioned above, have been relatively stiff and rigid, such that they fail to conform to the shape of the vagina after insertion to block flow through the vaginal cavity.

For best results, such a tampon is positioned centrally in the pear-shaped vaginal cavity with one end resting in the narrower lower end of the vagina adjacent the vaginal orifice. Even in this position, menstrual fluid will flow along the side walls of the vagina past the lower end of the tampon to leak through the vaginal orifice; this leakage being more extreme just after insertion before the tampon has expanded through absorption. In practice, it has been extremely difficult to position these tampons on center in the vagina and to maintain them there after insertion. It is obvious that when the tampon lies to one side of the vaginal cavity leakage will increase, sometimes to such an extent that fluid may flow in a direct course from the cervix to the vaginal orifice. Thus, prior tampons provide no insurance against leakage, especially just after insertion, and have at times caused considerable discomfort and embarrassment to women using them.

It is therefore an object of this invention to provide a tampon which will provide an effective barrier to the flow of menstrual fluid.

It is another object of this invention to provide a tampon within the practical size limits discussed above which will substantially prevent all leakage from the moment of insertion, without sacrificing absorptive capacity.

It is a further object of this invention to provide a tampon which is comfortable to wear.

Other and further objects of the invention will be apparent from the following description and attached claims taken together with the drawings wherein:

Fig. 1 is a schematic sectional view taken along the transverse plane of the vagina running through the cervix and the vaginal orifice, showing a tampon of this invention immediately after insertion;

Fig. 2 is the same view taken some time after the tampon has been in position and has increased in size due to absorption of moisture;

Fig. 3 is an isometric view of a web of absorbent material before it is compressed to form a tampon of this invention;

Fig. 4 is an isometric, fragmented view of another web of absorbent material which may be used to form a tampon of this invention;

Fig. 5 is a view of the web of Fig. 4 folded approximately in half prior to compressing to form the tampon;

Fig. 6 is a view in elevation showing the web at the beginning of compression;

Fig. 7 is an elevation of a completed compressed tampon of this invention made from the web shown in Figs. 4 and 5;

Fig. 8 is an elevation of another completed compressed tampon of this invention made from the web shown in Fig. 3; and

Fig. 9 is an isometric view of a carrying and inserting tube and plunger which may be used with the tampon of this invention.

I have discovered that if a tampon within the practical size limits discussed above is made sufficiently flexible, it will bend on insertion to form a dam across the vaginal cavity which will virtually prevent all leakage from the moment of insertion.

I am aware that flexible tampons have been disclosed heretofore. U. S. Pat. No. 2,620,799 is directed to a flexible tampon which is formed by compressing a web of absorbent fibrous material greatly in its axial direction and relatively little in its radial direction. The tampon of my invention is an improvement thereover, as will become apparent.

During insertion, the leading end of a tampon must overcome the resistance of the collapsed upper and lower vaginal walls and push them apart to make room for the tampon itself. This resistance arises not only from the bodily pressures which tend to keep the vagina collapsed, but also from the frictional resistance of the vaginal walls which possess many folds or corrugations and are unlubricated except for whatever menstrual fluid may be present at the time of insertion. Referring to the drawings, if a tampon 11 is made sufficiently flexible, the above-described wall resistance will cause the leading end 12 to bend as the tampon is pressed inwardly until one side of the tampon at this end comes in contact with one side of the vaginal cavity at A and the opposite side of the tampon at the other end contacts the other side of the cavity B. Since the tampon remains in contact with the upper and lower vaginal walls along its length and forms a dam across the vaginal cavity between the points A and B, flow of fluid through the vagina is effectively blocked from the moment insertion is completed.

Fig. 1 shows a tampon of this invention immediately after insertion, while Fig. 2 shows such a tampon some time after it has expanded after absorbing a certain amount of menstrual fluid. While the points of contact A and B tend to shift slightly along the sides of the vaginal cavity as the tampon expands, a good deal of the expansion is taken up by the increased bending of the tampon itself. This bending, in turn, tends to increase the pressure at the points of contact slightly to provide a more effective seal.

To measure the tampon flexibility, I use a "Gurley R. D. Stiffness Tester" such as described on page 43 of the December 30, 1934, issue of the Paper Trade Journal, loading the pointer with two hundred grams placed at four inches below the "center." I place the clamp on the clamp arm with its lower edge one inch from the end of the pointer in the vertical position of the arm. Then I position a tampon of this invention in the clamp with a length of one-and-one-quarter inches extending below the lower edge of the clamp and operate the tester to take readings as described in the above publication. When I refer in the following description and claims to a "Gurley Stiffness Reading," I mean a reading which would be obtained by testing under the above-described conditions.

I have found that tampons which give "Gurley Stiffness Readings" below 2.8 are sufficiently flexible to bend properly on insertion and come within the scope of this invention. I have also found that I can obtain this flexibility without sacrificing absorptive capacity. In other words. I can produce a tampon which will give a "Gurley Stiffness Reading" below 2.8 and have a fiber weight within the practical competitive range of absorptive capacity.

To illustrate, I take a straight strip or web 13 of absorbent fibers, said web being relatively long as hereinafter set forth, which may be held together by a cord 14 stitched along the length of the web, place this web in a cylinder 15 having an inner diameter corresponding to the desired tampon diameter, and compress the web with a piston 16 to the desired length of tampon. The web may be placed or positioned in the cylinder by hand or by any suitable means and the sides of the cylinder may be readily movable with respect to one another such that they may be opened to allow the web to be inserted more easily and then closed to define the desired tampon diameter.

In Fig. 4, there is shown another web 17 of absorbent fibrous material from which the tampon of this invention is suitably made. The fibers in this relatively long, straight web are arranged to extend predominantly in the direction of the length of the web. As shown in Fig. 4, the web may be folded upon itself lengthwise to about one-third its original width and a withdrawal string 18 fastened to the folded web approximately at the mid-

point of its length. The web is then folded at the midpoint of its length in the manner shown in Fig. 5, placed in cylinder 15, and compressed mainly along the direction of its length to form the tampon.

Any suitable absorbent material may be used although I prefer the more highly absorbent fibers such as cotton, rayon, paper, hemp, or wool. Combinations of suitable fibers and additions to the tampon such as medicaments, deodorants, lubricants, etc., are also within the spirit of this invention.

The weight of the fibers in the finished tampon is, of course, equivalent to the weight of the fibers in the web. I have mentioned that, generally speaking, tampon stiffness increases and, conversely, flexibility decreases, as the density, or weight-to-size relationship, of the tampon increases. Within the practical size ranges discussed hereinbefore of from about one-and-one-half inches to slightly less than two inches in length and from approximately seven-sixteenths to approximately five-eighths of an inch in diameter, practical and competitive considerations dictate that the weight of the fibers in the tampon be from at least about twenty to about sixty grains of cotton or an amount of fibers equvalent in absorptive capacity to those weights of cotton; the lower weights corresponding to the lower tampon sizes and diameters and the higher weights to the higher tampon sizes and diameters. A very suitable range of weights for the regular size tampons, which constitute the majority sold, is from at least about thirty-five grains to about forty-three grains.

I have found that the flexibility obtained is in some way a function of the amount of longitudinal compression, or the relation of the original strip or web length to that of the finished tampon; that is, the ratio of the length of the strip or web before compression to the length of the finished tampon. Within the above ranges of size and weight, I begin to reach the desired flexibility at a web-to-tampon length ratio of about 2.6 to 1 and obtain greater flexibility as the ratio is increased. The strip or web lengths referred to are those lengths measured just prior to compression. For example, if a web of the type shown in Figs. 4 and 5 is used to form the tampon, the length of the web is measured in its folded form, as shown in Fig. 5.

In the smaller commercial tampon sizes noted above, as illustrated by the junior and regular sizes, the desired flexibility may be obtained by using a web at least about 2.6 times as long as the tampon and, in the larger tampon sizes, as illustrated by the super size, by using a web at least about three times as long as the length of the tampon. For example, in the smaller tmpons, i. e., seven-sixteenths of an inch in diameter, one-and-one-half inches long and weighing thirty grains, the desired "Gurley Stiffness Reading" of below 2.8 may be obtained by using a web about four inches long. For a tampon one-and-nine-tenths inches long, five-eighths of an inch in diameter and weighing fifty-five grains, a web about six inches long is used. Longer webs may be used but, to simplify manufacture of the tampon, I prefer to use webs whose lengths are about equal to or slightly exceeding the lengths noted above. A tampon which gives a "Gurley Stiffness Reading" of from about 1.5 to about 2.5 is preferred because it has the desired flexibility to provide good protection and may be easily inserted intravaginally.

As noted above, flexibility generally decreases as the density, or weight-to-size relationship of the tampon, increases. For example, if the diameter of the tampon of established weight is decreased, or the weight of fibers in a tampon of established size increased, the length of the web from which the tampon is formed is also increased to provide the tampon with the desired flexibility.

It appears that the great flexibility and resiliency of the tampon of this invention is due to the number, depth, and character of the folds or creases which result during compression. A multiplicity of irregularly spaced creases and folds, either transverse or longitudinal, of different

sizes and of varying and relatively great depth are formed. Also, many minor creases and folds giving an appearance of superficial transverse striations are formed, apparently involving some crimping or creasing of the fibers, and extend substantially over the entire length of the tampon. Fig. 6, exaggerated for illustrative purposes, shows the beginning of the formation of the irregularly spaced creases and folds of relatively great depth occurring at the beginning of compression of the web. Fig. 7 shows a finished tampon **11**, formed from the web shown in Figs. 4 and 5, with irregularly spaced creases and folds **19**, and the transverse striations **20** formed in the compression process. This structure apparently gives the tampon its marked characteristics of softness, resilience, and flexibility which makes it comfortable to wear and at the same time causes it to assume a position in the vagina to serve the advantages herein set forth. Since the tampon is compressed mainly in a longitudinal direction, it will tend to expand mainly in that direction, rather than radially, as it absorbs menstrual fluid, and thus will not increase appreciably in diameter to cause discomfort or hinder removal.

In Fig. 8, there is shown another illustrative example of a tampon **21** prepared in accordance with this invention which is formed from the web **13** in Fig. 3. In this web, the fibers are arranged to extend predominantly transversely to the length of the web and are held together by stitching with cord **14**. As a result of the compression process, tampon **21** is formed with transverse surface striations **22** and creases and folds **23** similar to those formed when the tampon is formed from a web whose fibers are arranged to extend predominantly longitudinally to the length of the web. In addition, there may be some longitudinal folding **24** resulting from the compression process.

The completed tampon may be inserted in the open end of a carrying and dispensing tube **25** having a plunger, not shown, which may be operated by a tubular extension **26** to eject the tampon. The tube may be inserted through the vaginal orifice and the plunger operated to position the tampon in the vaginal cavity as described more fully hereinbefore.

It will be seen that I have provided a tampon within the practical limits of size and absorptive capacity which will substantially prevent all leakage from the moment of insertion. This tampon, by virtue of its flexibility, bends to form a dam across the vaginal cavity which effectively blocks the flow of menstrual fluid, and by virtue of its flexibility and softness conforms to the often irregular shape of the vagina to provide a maximum of comfort during use.

This application is a continuation-in-part of my copending applications Ser. Nos. 339,651, now abandoned, and 339,652, both filed March 2, 1953.

I claim as my invention:

1. A compressed cylindrical tampon of the type described compressed mainly longitudinally and having a fiber weight of at least thirty-five grains and sufficient flexibility to give a "Gurley Stiffness Reading" below 2.8.

2. A compressed cylindrical tampon of the type described compressed mainly longitudinally and having a weight of fibers at least equivalent in absorptive capacity to thirty-five grains of cotton and having sufficient flexibility to give a "Gurley Stiffness Reading" below 2.8.

3. A compressed cylindrical tampon of the type described compressed mainly longitudinally and having a weight of cotton fibers of at least thirty-five grains and sufficient flexibility to give a "Gurley Stiffness Reading" below 2.8.

4. A compressed cylindrical tampon of the type described having a diameter of from about seven-sixteenths to about five-eighths of an inch, a length of from about one and one-half to about two inches, and a weight of absorbent fibers of from about twenty to about sixty grains, said tampon being compressed mainly longitudinally from a strip of said fibers, the ratio of the length of said strip to the tampon length varying from at least about 2.6 to 1 in the lower portion of said range of tampon sizes to at least about 3 to 1 in the upper portion of said range of tampon sizes, said tampon having sufficient flexibility to give a "Gurley Stiffness Reading" below 2.8.

5. A compressed cylindrical tampon of the type described having a diameter of from about seven-sixteenths to about five-eighths of an inch, a length of from about one and one-half to about two inches, and a weight of absorbent fibers of from about twenty to about sixty grains, said tampon being compressed mainly longitudinally from a strip of said fibers, the fibers of said strip arranged to extend predominantly in the direction of the length of said strip, the ratio of the length of said strip to the tampon length varying from at least about 2.6 to 1 in the lower portion of said range of tampon sizes to at least about 3 to 1 in the upper portion of said range of tampon sizes, said tampon having sufficient flexibility to give a "Gurley Stiffness Reading" below 2.8.

6. A compressed cylindrical tampon of the type described having a diameter of from about seven-sixteenths to about five-eighths of an inch, a length of from about one and one-half to about two inches, and a weight of absorbent fibers of from about twenty to about sixty grains, said tampon being compressed mainly longitudinally from a strip of said fibers, the fibers of said strip arranged to extend predominantly in the direction of the length of said strip, said strip being folded approximately at the midpoint of its length, the ratio of the length of said folded strip to the tampon length varying from at least about 2.6 to 1 in the lower portion of said range of tampon sizes to at least about 3 to 1 in the upper portion of said range of tampon sizes, said tampon having sufficient flexibility to give a "Gurley Stiffness Reading" below 2.8.

7. A compressed cylindrical tampon of the type described having a diameter of from about seven-sixteenths to about five-eighths of an inch, a length of from about one and one-half to about two inches, and a weight of absorbent fibers of from about twenty to about sixty grains, said tampon being compressed mainly longitudinally from a strip of said fibers, said strip being folded approximately at the midpoint of its length, the ratio of the length of said folded strip to the tampon length varying from at least about 2.6 to 1 in the lower portion of said range of tampon sizes to at least about 3 to 1 in the upper portion of said range of tampon sizes, said tampon having sufficient flexibility to give a "Gurley Stiffness Reading" below 2.8.

8. A compressed cylindrical tampon of the type described having a diameter of from about seven-sixteenths to about five-eighths of an inch, a length of from about one and one-half to about two inches, and a weight of absorbent fibers equivalent in absorptive capacity of from about twenty to about sixty grains of cotton, said tampon being compressed mainly longitudinally from a strip of said fibers, the ratio of the length of said strip to the tampon length varying from at least about 2.6 to 1 in the lower portion of said range of tampon sizes to at least about 3 to 1 in the upper portion of said range of tampon sizes, said tampon having sufficient flexibility to give a "Gurley Stiffness Reading" below 2.8.

9. A compressed cylindrical tampon of the type described having a diameter of from about seven-sixteenths to about five-eighths of an inch, a length of at least about one and one-half inches and a weight of absorbent fibers of from about twenty to about sixty grains, said tampon being compressed mainly longitudinally from a strip of said fibers, the ratio of the length of said strip to the tampon length varying with increasing tampon size of from at least about 2.6 to 1 in the lower portion of said range of tampon sizes to at least about 3 to 1 in the upper portion of said range of tampon sizes,

said tampon having sufficient flexibility to give a "Gurley Stiffness Reading" below 2.8.

10. A compressed cylindrical tampon of the type described having a diameter of from about seven-sixteenths to about five-eighths of an inch, a length of from about one and one-half to about two inches and a weight of absorbent fibers of from about twenty to about sixty grains, the weight of the tampon being greater with increasing tampon size, said tampon being compressed mainly longitudinally from a strip of said fibers, the ratio of the length of said strip to the tampon length varying as a function of said tampon sizes of from at least about 2.6 to 1 in the lower portion of said range of tampon sizes to at least about 3 to 1 in the upper portion of said range of tampon sizes, said tampon having sufficient flexibility to give a "Gurley Stiffness Reading" below 2.8.

11. A compressed cylindrical tampon of the type described having a diameter of from about seven-sixteenths to about five-eighths of an inch, a length of from about one and one-half to about two inches, and a weight of absorbent fibers of from about twenty to about sixty grains, said tampon being compressed mainly longitudinally from a strip of said fibers, the ratio of length of said strip to the tampon length varying from at least about 2.6 to 1 in the lower portion of said range of tampon sizes to at least about 3 to 1 in the upper portion of said range of tampon sizes, said tampon having sufficient flexibility to give a "Gurley Stiffness Reading" of about from 1.5 to about 2.5.

12. A compressed cylindrical tampon of the type described having a diameter of from about seven-sixteenths to about five-eighths of an inch, a length of from about

one and one-half to about two inches, and a weight of absorbent fibers of from about twenty to about sixty grains, said tampon being compressed mainly longitudinally from a strip of said fibers, the fibers of said strip arranged to extend predominantly transversely to the length of said strip, the ratio of the length of said strip to the tampon length varying from at least about 2.6 to 1 in the lower portion of said range of tampon sizes to at least about 3 to 1 in the upper portion of said range of tampon sizes, said tampon having sufficient flexibility to give a "Gurley Stiffness Reading" below 2.8.

13. A compressed cylindrical tampon of the type described having a diameter of from about seven-sixteenths to about five-eighths of an inch, a length of from about one and one-half to about two inches, and a weight of absorbent fibers of from about twenty to about sixty grains, said tampon being compressed mainly longitudinally from a strip of said fibers, the fibers of said strip arranged to extend predominantly transversely to the length of said strip, said fibers being held together by stitching extending along the length of said strip, the ratio of the length of said strip to the tampon length varying from at least about 2.6 to 1 in the lower portion of said range of tampon sizes to at least about 3 to 1 in the upper portion of said range of tampon sizes, said tampon having sufficient flexibility to give a "Gurley Stiffness Reading" below 2.8.

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