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(71) Applicant: **United Catalysts Incorporated**
1227 South 12th Street
Louisville
Kentucky 40232 (US)

(72) Inventor: **Klett, George**
101 Christine Drive
Belen,
New Mexico 87002 (US)
Inventor: **Cordonnier, Paul, Société d'Exploitation**
du Conditionnement,
12, Rue du Port de la Colle
B.P. No. 11,
F-77670 Saint-Mammes (FR)
Inventor: **Witte, Stephan, Société d'Exploitation**
du Conditionnement,
12, Rue du Port de la Colle
B.P. No. 11,
F-77670 Saint-Mammes (FR)

(74) Representative: **Patentanwälte Dipl.-Ing. R. Splanemann Dr. B. Reitzner Dipl.-Ing. K. Baronetzky**
Tal 13
D-80331 München (DE)

(54) Liquid absorbing packet.

(57) A packet for immobilizing a liquid comprised of a liquid permeable sheet formed into an envelope wherein two of the sides of the sheet are sealed to form a pair of end seals wherein the two remaining sides of the sheet are sealed together to form a center seal, wherein contained within the envelope is a quantity of swellable absorbent granules which swell to a size greater than the size of those granules in their dry condition, and wherein as the liquid absorbing granules swell, they break the center seal of the envelope to release the liquid absorbing granules to the outside environment of the package to absorb liquid. Also disclosed is a process for their production.

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Background of Invention

1. Field of Invention.

This invention relates to liquid absorbing packets. More specifically this invention discloses to a packet containing liquid absorbing granules for immobilizing a liquid wherein the swelling of the liquid absorbing granules breaks apart the packet at a predetermined location on the packet thereby quickly releasing the liquid absorbing granules from the packet to increase the speed of absorption of the liquid absorbing granules.

2. Prior Art.

Desiccant containers which operate to absorb water vapor, liquids and the like are known in the art. Generally these containers are composed of water or water vapor permeable sheets of fibrous material securely bonded together at their edges containing a desiccant, such as silica gel. The volume of water or water vapor capable of being absorbed by the container is determined by the absorbent capacity of the desiccant material within the container.

More recently containers containing liquid absorbing materials for absorbing large quantities of liquid have been designed. These liquid absorbing materials are capable of absorbing relatively large amounts of liquids as disclosed, for example in U.S. Patent No. 3,661,815, which discloses a water insoluble granular solid comprising alkali metal carboxylate salts of a starch-polyacrylonitrile graft copolymer. See, also, U.S. Patent No. 4,224,366 and 4,124,116. Liquid absorbing and immobilizing granules such as sodium polyacrylate are known in the industry and are disclosed, for example, in U.S. Patent Nos. 4,853,266, 4,748,069 and 4,749,600.

To achieve greater absorption the liquid absorbing and immobilizing packets release the liquid absorbing material from their packets to the surrounding environment. One choice for enabling this release is disclosed by U.S. Patent Nos. 4,748,069, 4,749,600, 4,853,266, 4,725,465, 4,124,116 and 4,224,366. Each of these patents discloses a packet whose envelope is composed of a liquid soluble material. For example, in U.S. Patent No. 4,224,366, upper and lower contiguous sheets, which are bonded together, are fabricated from a paper which dissolves in the presence of moisture or a liquid to release the absorbent granules from the packet. A particular disposable packet manufactured by Multiform Desiccants, Inc. and disclosed, for example, in U.S. Patent Nos. 4,748,069, 4,749,600 and 4,853,266, contains sodium polyacrylate as the absorbent material contained within a degradable starch paper envelope. When a liquid comes into contact with such a degradable envelope, the liquid first dissolves the envelope and then, only after such dissolution, the liquid-absorbing materials are released from the envelope to absorb the liquid. A slightly different design of the envelope is disclosed in U.S. Patent No. 4,725,465 wherein the interior surface of the water soluble paper which envelopes the absorbent granules is coated with an adhesive in a grid or dot-like pattern. Once this paper is contacted by a liquid, it dissolves to expose the absorbent granules to the liquid to be absorbed.

While each of these patents discloses products which provide a means for the absorption of liquids, each requires that the packet or envelope which encloses the liquid absorbing material degrade or decompose prior to the release of the liquid absorbing granules into the environment for full absorption of liquid. Improved designs for faster and more efficient release of absorbent granules from such packets are necessary.

Therefore, it is an object of this invention to provide a liquid absorbing and immobilizing packet which will quickly absorb and immobilize a relatively large quantity of liquid.

It is another object of this invention to disclose a liquid absorbing and immobilizing packet which will come apart at its seams to release quickly the liquid absorbing material into the contiguous environment.

It is a still further object of this invention to disclose a liquid absorbing and immobilizing packet wherein the envelope of the packet is liquid permeable and wherein at least one of the seams of the packet comes apart upon expansion of liquid absorbing granular material contained within said envelope to release quickly the liquid absorbing granular material into the contiguous environment.

It is a further object of this invention to provide a process for the production of a liquid absorbing and immobilizing packet which packet will quickly and efficiently release liquid absorbing and immobilizing material contained within a packet into the contiguous environment.

These and other objects and features of the present invention will become apparent to those skilled in the art from a consideration of the following detailed description, drawings and claims. The description, along with the accompanying drawings, provides a selected example of construction of the product and the process to illustrate the invention.

Summary of Invention

In accordance with the present invention there is provided a packet for immobilizing a liquid, comprised of a liquid permeable sheet formed into an envelope wherein each of two of the sides of the

sheet are sealed to form a pair of seals, preferably end seals, wherein the two remaining sides of the sheet are sealed together to form a single seal, preferably a center seal running between the end seals, wherein contained within the envelope is a quantity of swellable, liquid absorbing granules which swell to a size greater than the size of those granules in their dry condition, and wherein as the liquid absorbing granules swell, they break the center seal to release the liquid absorbing granules into the environment outside of the packet to absorb liquid. In addition, there is disclosed a process for forming a packet for absorbing and immobilizing a liquid comprised of (a) forming an envelope comprised of a liquid permeable sheet, wherein each of two of the sides of the sheet are bonded to form a pair of seals, preferably end seals, and wherein the two remaining sides are bonded together to form a seal, preferably a center seal, running between the end seals and (b) filling the envelope with a quantity of swellable liquid absorbent granules which swell to a size greater than the size of those liquid absorbent granules in their dry condition and wherein as the granules swell, they break the center seal of the envelope thereby releasing the liquid absorbent granules outside of the packet to absorb the liquid.

Brief Description of the Drawings

This invention will now be described with references to the accompanying drawings in which:

Figure 1 is a perspective view of the liquid absorbing packet.

Figure 2 discloses the filling of the packet and forming the center seal of the packet.

Figure 3 discloses the forming of the end seals of the packet.

Detailed Description of the Preferred Embodiment

Although the invention is adaptable to a wide variety of uses, it is shown in the drawings for purpose of illustration as embodied in a packet (10) for absorbing and immobilizing a liquid comprised of an envelope formed from a sheet of liquid permeable material, wherein said envelope contains a swellable, liquid absorbing and immobilizing granular material. The envelope is formed from a liquid permeable material, wherein the material contains microperforations for air and water permeability. Although the envelope material can be formed from any conventional water permeable material such as cellulose, polyvinyl alcohol, low density polyethylene, and nylon, it is preferably formed from a mixture of cellulose paper pulp and cellulose long fibers. To this combination may be added synthetic materials such as vinyl acetate, polyethylene, and other such additives. Other examples of water permeable films are plain cellophane (not moisture finished), glassine paper, parchment paper, nonwoven fabric films (including synthetic paper) and the like which permit a liquid to permeate through said material.

Referring now to Figure 1 the particular absorbent and immobilizing packet (10) is shown as an elongated, generally rectangular shaped packet. The envelope is formed from a sheet of the liquid permeable material as previously disclosed. Although the sheet may be formed into an envelope by any conventional method, it is essential that at least one of the seams be formed in such a manner as to permit breach of that seam of the envelope by the swelling of absorbent granules contained within the envelope. Thus, in one preferred embodiment two of the opposite sides of the sheet are folded onto themselves thus forming two end seals (12, 14). The two remaining opposite sides are joined together to form a center seal (16) running between the end seals. The end seals are bonded conventionally while the center seal is bonded under less pressure and heat to form a weaker seal, such that upon the expansion of the water swellable absorbent material, the end seals will retain their seal longer than the center seal. Thus, the center seal is sealed such that as the absorbent material swells, it will be easily breached to permit the absorbent material to be released outside of the packet, thus making such absorbent material immediately available to absorb liquid which is present outside of the packet.

When the preferred cellulose material is used for the liquid permeable sheet, the two end seals are sealed by a conventional sealing operation wherein the edges are heated to a temperature of from about 200 °F. to 250 °F., preferably from about 230 °F. to about 240 °F., placed under a pressure of about 15 to 35 psi, preferably from about 20 to about 30 psi, wherein such pressure is held on such seals for a dwell time of at least 1 second and preferably from about 1 to about 5 seconds. In contrast, the center seal is sealed at a reduced temperature and under a reduced pressure. Thus, preferably, the center seal is formed at a temperature of from about 190 °F. to about 240 °F. and preferably from about 225 °F. to about 235 °F. and under a pressure of less than 15 psi and preferably from about 3 to about 10 psi, wherein said pressure is retained for a dwell time of less than about 5 seconds and preferably from about 1 to about 3 seconds. As a result of the reduced temperature and reduced pressure placed upon the center seal, the center seal is not as secure as are the two end seals. By reducing the strength of the center seal, it will breach quite easily when the absorbent material contained within

the packet expands against the center seal.

The liquid absorbent material which is placed within the packet must swell upon contact with liquid. Suitable materials for use in the packet will be those normally utilized for the absorption of liquids. These materials include alkali metal carboxylate salts of starch - polyacrylonitrile, graph copolymers as described in U.S. Patent No. 3,661,815 and products which will absorb, gel or thicken a particular liquid, such as carboxymethyl cellulose, cellulose ethers, polyvinyl pyrolidone, starch, dextrose, gelatin, pectin, and preferably sodium polyacrylate. The preferred material is a sodium polyacrylate absorbent polymer, lightly cross-linked produced, for example, by Chemdal Corp. under the trade name Aridall. The preferred material has the capacity to absorb or immobilize large volumes of liquids, preferably from about 180 ml/g to about 220 ml/g of a distilled water solution. Preferably, the absorbent material will absorb a 1% saline solution at a capacity of about 33 ml/gm to about 40 ml/gm. It is required that this material be able to absorb and immobilize liquids preferably forming a gel-like substance of at least about twice the volume of the dry material. When the preferred sodium polyacrylate is used, the majority of the absorbent granules preferably have a size of no more than about 1000 micron to about 150 microns.

For the packet to effectively and efficiently absorb liquid by breaching the center seal of the envelope, it is preferable that the liquid absorbing material occupy at least about 30 percent and preferably at least about 50 percent of the volume of the packet when the packet is empty. As the preferred sodium polyacrylate material can absorb up to at least about 200 times its weight in water and about 30 to about 40 times its weight of a one percent saline solution, upon contact with a liquid the liquid absorbing material will immediately swell and breach the center seal thereby releasing the liquid absorbing material to the surrounding environment without first requiring the envelope to be dissolved.

It is anticipated that the packets will be manufactured by first forming the sheet of the envelope into a tube, preferably around a fill tube using a single running sheet of the envelope material. See Figure 2. The tube will be formed by folding the sheet upon itself inwardly and then heat sealing the edges to form a seal, preferably the center seal. As previously discussed, the strength of the center seal is closely monitored as it must be breachable upon swelling of the absorbent material. The center seal (16) is then formed by sealing opposite sides of the packet together under heat and pressure, for example, by use of conventional spring loaded rollers (20) under the heat and pressure limitations previously discussed. It is critical that the heat and pressure that is used to form the center seal be less than the heat and the pressure that is used to form the end seals as has been previously discussed. The general process for the formulation of this seal is disclosed in Figures 2 and 3. As the tube is formed, the liquid absorbing material is funneled into the tube to fill it to the extent previously discussed, which is at least about one-third of the space and preferably at least one-half of the space of the envelope when empty. The center seal can be formed by bringing the sides of the packet together around a fill tube (18). See Figure 2. While the size of the packet can be any conventional size, preferably it is approximately 50 to about 65 millimeters in width and about 120 to about 135 millimeters in length. The width of the center seal can vary, but should be in the range of about 2 to about 8 millimeters and preferably about 3 to about 5 millimeters. Once the center seal is formed, the end seals are formed in a continuous forming process as is shown in Figure 3. Once again, conventional spring loaded heat seal rollers (22) are used which are placed at a higher heat and pressure than was used for forming the center seal. On the surface of those rollers are heated mandrels (24) which extend from the body of the roller and which press together to form the end seals. By the adjustment of the location of the spring loaded heat seal rollers and the distance of extension of the mandrels, sufficient pressure and heat are brought to bear upon the end seals to result in a stronger bond for those seals than for the center seal, as has previously been discussed. The width of these seals is not particularly critical but should be at least about 5 millimeters and preferably at least about 8 millimeters in width. After the center seal and the end seals are formed, the continuous roll of packets is cut to form individual packets by a conventional cutting process.

The packet must contain a sufficient quantity of the liquid absorbing material. Preferably the material fills at least about 1/3 of the interior space of the packet and more preferably, at least about 1/2 of that space.

The packet can be utilized in a variety of ways to contain liquid spills. As a preventative or precautionary manner, the packet can be placed in secondary containers, such as shipping cases to immobilize liquids from broken or damaged primary containers such as bottles or cans. As an after spill measure, the packets can be placed in or surrounding a spilled chemical or liquid to control flow and/or spreading.

Upon being placed in liquid, the liquid will immediately pass through the liquid permeable envelope material to contact the absorbent material. That absorbent material will immediately swell and

breach the center seal of the packet within a matter of a few seconds, preferably no more than about 5 seconds, thus releasing the absorbent material outside of the packet to permit full utilization of the absorbent material. This provides a quick and efficient packet for the absorption of a liquid.

Examples

Comparative Example 1

A liquid absorbing packet manufactured by Multiform Desiccants, Inc. called DriMop, which is 32.8 mm. in length and 32.8 mm. in width, is used as the comparison product. 50 milliliters of a 1% saline solution is placed within a 500 ml container. The Multiform packet is dropped into the saline solution. Approximately 10-20 seconds after exposure to the saline solution, the envelope containing the Multi-Form absorbent material dissolves to release the absorbent material contained within the packet. Full absorption of the liquid occurs within 180 seconds.

Example 2

A packet of approximately the same size as the Multiform packet but formed by the process of the instant invention containing approximately the same amount of liquid absorbent material as was utilized in comparative example 1 is prepared. The composition of the envelope is HDPE, i.e., a poly vinyl chloride, vinyl acetate, cellulose composition. The liquid absorbing material is a sodium polyacrylate absorbent polymer, lightly cross-linked and supplied by Chemdal Corp. under the name Aridall, ASAP No. 1100. The packet containing the liquid absorbing material is placed in a 500 ml container containing 50 milliliters of a 1% saline solution. Within 2 seconds the center seal is breached, thus exposing the saline solution to the liquid absorbent material contained within the packet. Within 30 seconds the entire amount of the liquid is absorbed.

As is apparent from the above examples, the product of the instant invention absorbs liquids, especially saline solutions, more quickly than that of the comparative example product formed by conventional procedures.

Claims

1. A packet for immobilizing a liquid comprising a liquid permeable sheet containing four sides formed into an envelope, wherein each of two of the sides of the sheet are sealed to form a pair of seals for the packet, wherein the two remaining sides of the sheet are sealed together to form a third seal for the packet, wherein one of the seals for the packet is less securely sealed than the other two seals, wherein contained within the envelope are swellable, liquid absorbent granules which swell upon contact with liquid to a size greater than the size of the swellable absorbent granules in their dry condition, and wherein as the granules swell upon contact with liquid, they breach the less securely sealed seal of the envelope prior to breaching of the two more securely sealed seals to release the swellable liquid absorbent granules outside of the packet to absorb the liquid.

2. The packet of Claim 1 wherein the swellable absorbent granules are comprised of a sodium polyacrylate, wherein the particle size is preferably no more than about 1000 microns to about 150 microns.

3. The packet of Claims 1 or 2 wherein the liquid permeable sheet is formed from a mixture of cellulose paper pulp and cellulose long fibers and, preferably, has microperforations for air and water permeability.

4. The packet of any one of Claims 1 to 3 wherein the more securely sealed seals are formed at a temperature from about 200 °F. to about 250 °F. and under a pressure of about 15 to 30 psi for a 5 second or less dwell time, and wherein the less securely sealed seal is formed at a temperature less than the temperature used to form the more securely sealed seals and under a pressure less than that which is used to form the first two seals.

5. The packet of any one of Claims 1 to 4 wherein the swellable absorbent granules in their dry condition occupy at least about one-third, preferably at least about one-half, of the volume of the envelope when the envelope is empty.

6. The packet of any one of Claims 1 to 5 wherein the liquid absorbent granules absorb at least about 30 times their weight of a 1% saline solution.

7. A process for absorbing and immobilizing a liquid comprised of

   (a) forming an envelope comprised of a liquid permeable sheet containing four sides formed into an envelope wherein each of two of the sides of the sheet are sealed to form a pair of seals for the envelope, wherein the two remaining sides of the

sheet are sealed together to form a third seal for the envelope, wherein one of the seals is less securely sealed and the remaining two seals are more securely sealed, and

(b) prior to sealing all of the sides of the envelope, filling the envelope with swellable absorbent granules which upon contact with the liquid swells to a size greater than the size of the granules in their dry condition and wherein as the granules swell, they break the less securely sealed seal to release the granules outside of the packet to absorb the liquid.

8. The process of Claim 7 wherein the swellable absorbent granules are defined as in Claim 2, wherein the liquid permeable sheet is formed from a mixture of cellulose paper pulp and cellulose long fibers, and preferably, has microperforations for air and water permeability.

9. The process of Claims 7 or 8 wherein the more securely sealed seals are formed at a temperature from about 200 °F. to about 250 °F. and under a pressure of about 15 to 30 psi for a 5 second or less dwell time, and wherein the less securely sealed seal is formed at a temperature less than the temperature used to form the more securely sealed seals and under a pressure less than that which is applied to the first two seals.

10. The process of any one of Claims 7 to 9 wherein the swellable absorbent granules in their dry condition occupy at least one-third, preferably at least one-half, of the volume of the envelope when the envelope is empty.

11. The process of any one of Claims 7 to 16 wherein the liquid absorbent granules absorb at least about 30 times their weight of a 1% saline solution.

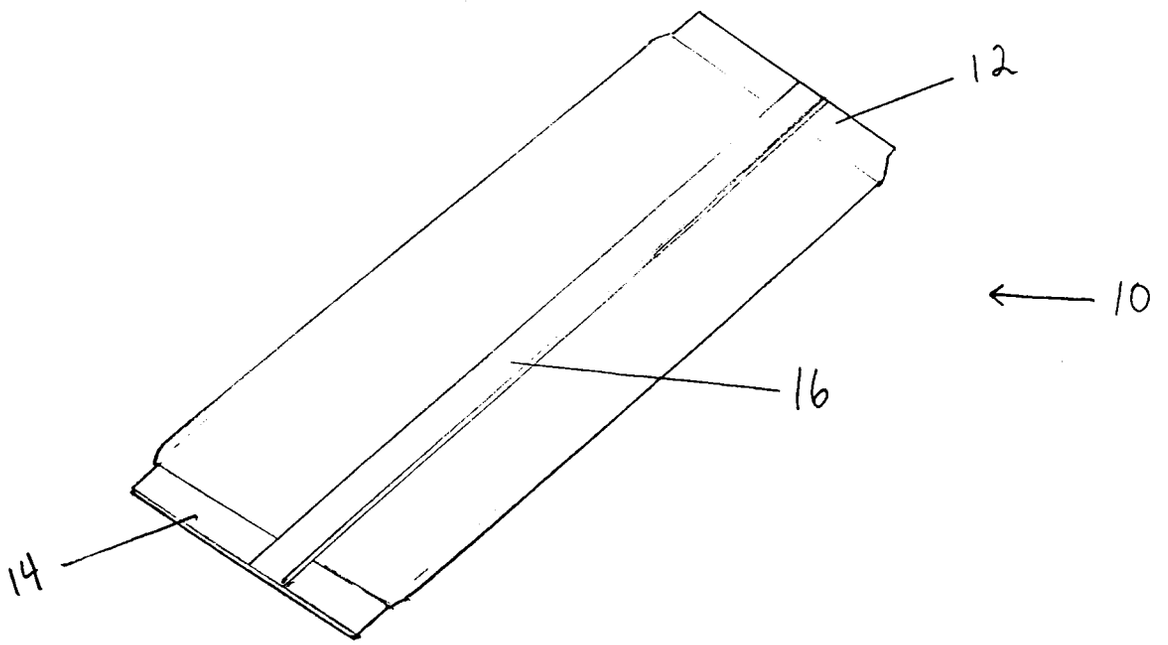

FIG. 1

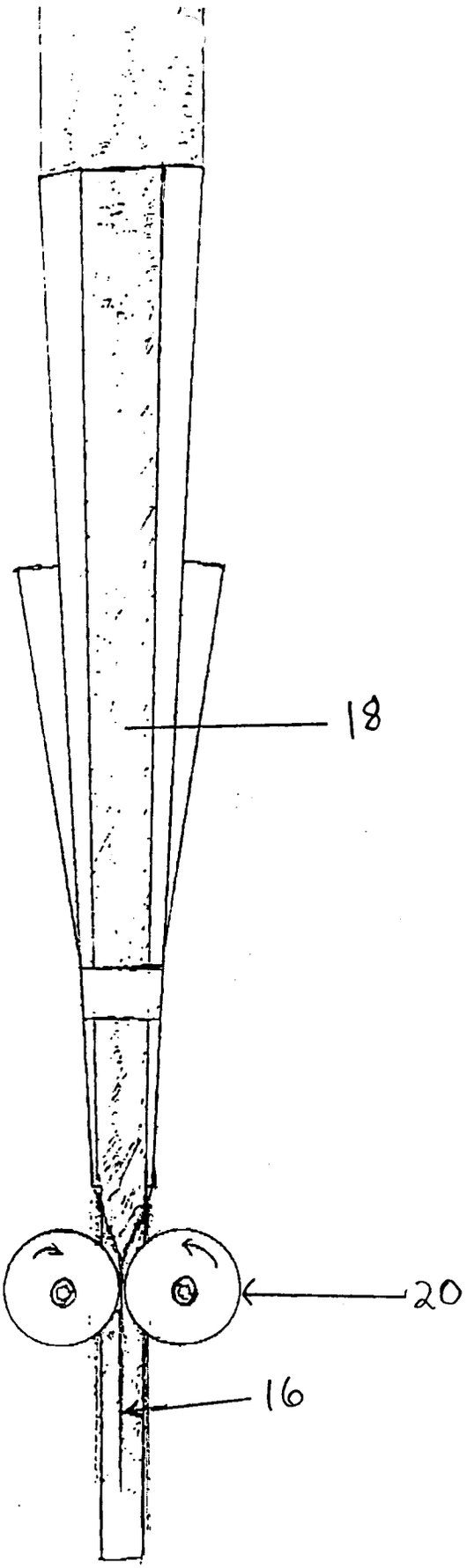

FIG 2

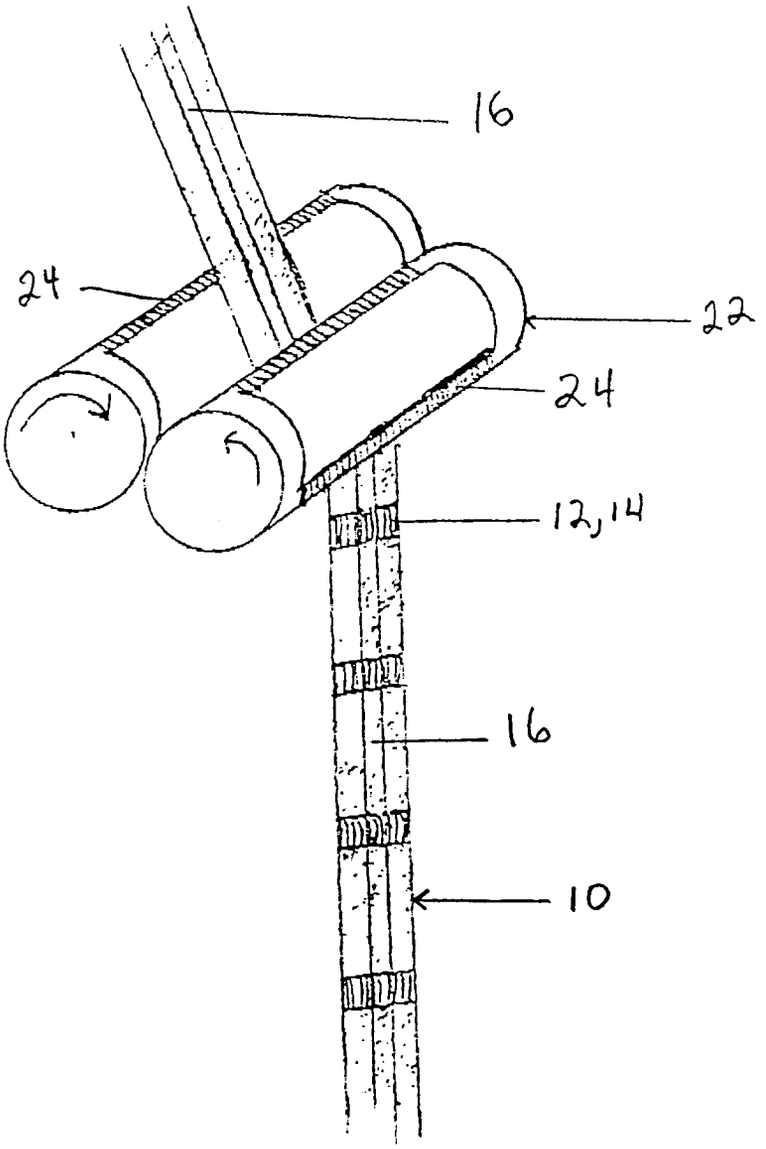

FIG 3