



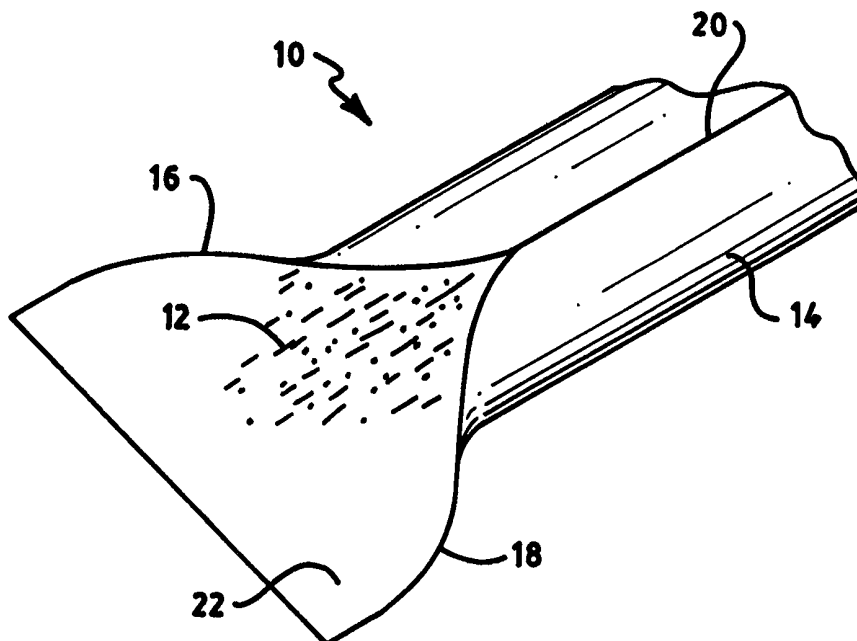
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b>  <b>A47L 13/16</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 99/60912</b>  <b>(43) International Publication Date:</b> 2 December 1999 (02.12.99)
<b>(21) International Application Number:</b> PCT/US99/12013  <b>(22) International Filing Date:</b> 28 May 1999 (28.05.99)  <b>(30) Priority Data:</b> 60/087,244      29 May 1998 (29.05.98)      US 09/289,483      9 April 1999 (09.04.99)      US  <b>(71) Applicant:</b> KIMBERLY-CLARK WORLDWIDE, INC. [US/US]; 401 N. Lake Street, Neenah, WI 54956 (US).  <b>(72) Inventors:</b> TANNER, James, Jay; 222 North 11th Avenue, Winneconne, WI 54986 (US). CLARK, James, William; 4005 Devereux Chase, Roswell, GA 30075 (US). COTTON, James, Dennis; 2371 Mitchell Road, Marietta, GA 30062 (US).  <b>(74) Agents:</b> SIDOR, Karl, V. et al.; Kimberly-Clark Worldwide, Inc., 401 N. Lake Street, Neenah, WI 54956 (US).		<b>(81) Designated States:</b> AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the          claims and to be republished in the event of the receipt of          amendments.</i>

**(54) Title:** A LIQUID ABSORBENT SOCK AND SYSTEM FOR COLLECTING LEAKS AND SPILLS

**(57) Abstract**

An elongate, liquid absorbent sock for handling liquids. The sock includes: (1) a liquid absorbent core of loose absorbent material; (2) a flexible, liquid permeable cover containing the loose absorbent material and establishing the cross section of the sock; and (3) an adhesive layer on at least a portion of the liquid permeable cover. The cover may be a nonwoven web of fibrous material which may be apertured or may be treated to enhance liquid permeability. In one embodiment, the cover has sufficient strength so the absorbent sock can be used to wipe up liquid. The adhesive layer may be substantially continuous or substantially discontinuous and is desirably a pressure sensitive adhesive layer. The adhesive layer is adapted to secure the absorbent sock to a surface, to another absorbent sock, or to a device for wiping up liquid.



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

**A LIQUID ABSORBENT SOCK AND SYSTEM FOR COLLECTING LEAKS AND  
SPILLS**

5

**FIELD OF THE INVENTION**

This invention generally relates the field of absorbent  
10 socks or booms. More particularly, this invention relates to  
the field of liquid absorbent socks, methods of manufacturing  
liquid absorbent socks, and systems for collecting leaks and  
spills.

15 **BACKGROUND OF THE INVENTION**

Absorbent socks or booms are used to collect leaks and  
spills. These products are usually long, flexible tubular  
liquid permeable packages filled with absorbent material  
placed on horizontal surface to absorb water, oil or other  
20 liquids emanating from machinery, plumbing, storage  
containers, work areas or the like. In some instances, these  
socks may be displaced from their original position. For  
example, the socks may be knocked or dragged by moving  
equipment, buoyed-up by liquid, inadvertently kicked or  
25 pushed by workers, dislodged by vibrations, jets of air,  
steam and/or liquid in the work environment. Many of these  
absorbent socks are tubular in form and are filled with loose  
absorbent materials. The generally circular cross section of  
such socks tends to offer little resistance to displacement.

30 In addition to absorbing liquid, absorbent socks may also  
be used to temporarily block and/or channel flows or spills

of liquid. For example, if the volume of a flow or spill of liquid is too great for a sock to absorb, the sock may be used both to absorb some liquid and to prevent the uncontrolled spread of liquid over a floor by diverting the flow toward a catch basin, drain, collection of absorbent socks or the like. The sock may be used simply as a temporary barrier to liquid in a manner similar to a sandbag. Unfortunately, conventional absorbent socks rely on gravity to form a relatively water-tight seal or fit with the surface they are placed on to function effectively as a barrier to liquid flow. The surface where gravity is used to form a water-tight seal may be far away from the leak source and considerable distance can be covered by the leak before it contacts the sock. An example of such a situation is leakage down a wall. Absorbent socks that are filled with light-weight cellulosic material (e.g., pulp, sawdust, kenaf, ground corn cobs, wood chips, etc.), light-weight fibers may have a tendency to float away or be easily displaced unless several socks are arranged in parallel or are stacked on top of each other. Absorbent socks that are packed too tightly with absorbent material tend to be less flexible and are less effective at conforming to the surface they are placed on.

Accordingly, there is a need for an absorbent sock that tends to be stable, secure and resistant to displacement once it is put in place. There is also a need for an absorbent sock that readily conforms to a surface it is placed on to create a relatively liquid-tight seal or fit.

**SUMMARY OF THE INVENTION**

The problems and needs described above are addressed by the present invention which provides an elongate, liquid absorbent sock for handling liquids and collecting liquid spills and leaks.

The elongate, liquid absorbent sock includes: (1) a liquid absorbent core of loose absorbent material; (2) a flexible, liquid permeable cover containing the loose absorbent material and establishing the cross-section of the sock, and; (3) an adhesive layer on at least a portion of the liquid permeable cover.

The absorbent core may be formed of loose fibrous material, particulate material, one or more unconsolidated batts of fibrous materials, fibrous webs, fibrous tows or filaments and mixtures of the same. Alternatively and/or additionally, the absorbent core may include layers of fibrous and/ or particulate material. These layers may be separately formed in a web or batt forming process or may be layers of webs such as, for example, meltblown webs, spunbond webs, bonded-carded webs, hydraulically entangled webs and combinations of these materials. One feature of the present invention is that the absorbent core be relatively unconsolidated or loose such that the cross-section of the absorbent sock is defined by the flexible, liquid permeable cover rather than the absorbent core itself. Another feature of the present invention is that since the adhesive strip can prevent floating (even temporary or transient floating), it is possible to use much lower density absorbent cores that are more efficient at absorbing liquid and have greater absorbent capacity.

The flexible, liquid permeable cover may be a nonwoven web of fibrous material. For example, the cover may be selected from spunbond webs, meltblown webs, bonded-carded webs, hydraulically entangled webs and combinations of one or more of the same. The fibrous material used to form the cover may be any suitable material. Desirably, the fibrous material is a polyolefin such as, for example, polypropylene, polyethylene, propylene copolymers, ethylene copolymers, and blends or mixtures of one or more of these materials. In an aspect of the invention, the nonwoven web or cover material may be apertured and/or treated to enhance liquid permeability. For example, surfactant treatments, chemical etching, burning, corona discharge treatments or the like may be used.

Of course, it is contemplated that the cover may be a textile material such as a woven or knit material. The cover may also be a liquid permeable film such as, for example, a slit film or an apertured film.

Desirably, the cover will have sufficient strength so the absorbent sock can be used to wipe up liquid. For example, the cover may have desirable levels of abrasion resistance and/or tear strength so it may withstand frictional forces encountered during wiping or even scouring.

According to the invention, an adhesive layer is positioned on at least a portion of the liquid permeable cover. The adhesive layer may be substantially continuous or may be substantially discontinuous. Desirably, the adhesive layer is a pressure sensitive adhesive layer. In one embodiment of the present invention, the adhesive strip has a width or thickness sufficient to provide satisfactory adhesion to a surface such as, for example, a floor, a wall,

a section of a machine, pipe or tank, another absorbent sock, or a device for wiping up spills. Desirably, the adhesive layer runs along the entire length dimension of the cover. It is contemplated that the adhesive layer may be supplemented  
5 by or replaced with other attachment means such as mechanical fasteners (e.g., Velcro® hook and loop fasteners, eyes and hooks, snaps, strings, magnetic strips or the like).

In one aspect of the present invention, the flexible, liquid permeable cover may form flexible extensions at least  
10 at one end of the absorbent sock so that two or more absorbent socks may be joined in series by adhering the extension of one sock to a portion of the cover on an adjacent sock. The extensions of the cover may also be used to create a seal between the end of an absorbent sock and an  
15 adjacent wall or structure.

The present invention also encompasses a system for handling liquids and collecting liquid leaks and spills. The system involves:

(1) providing an elongate, liquid absorbent sock  
20 including:

a liquid absorbent core of loose absorbent material;

a flexible, liquid permeable cover containing the loose absorbent material and establishing the cross-section  
25 of the sock, and;

an adhesive layer on at least a portion of the liquid permeable cover; and

(2) securing the elongate, liquid absorbent sock to a surface utilizing the adhesive layer so that the liquid  
30 absorbent sock is configured to collect liquid leaks and spills.

The system includes securing the elongate, liquid absorbent sock to another elongate, liquid absorbent sock utilizing the adhesive layer. The system also includes securing the elongate, liquid absorbent sock to a device for  
5 wiping up liquid.

These and various other advantages and features of novelty which characterize the invention are pointed out with particularity in the claims annexed hereto and forming a part hereof. However, for a better understanding of the invention,  
10 its advantages, and the objects obtained by its use, reference should be made to the drawings which form a further part hereof, and to the accompanying descriptive matter, in which there is illustrated and described a preferred embodiment of the invention.

15

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 is a perspective view illustration of an exemplary liquid absorbent sock.

FIG. 2 is a perspective view illustration of an exemplary  
20 liquid absorbent sock.

FIG. 3 is an illustration of a detail of an exemplary liquid absorbent sock.

FIG. 4 is an illustration of a detail of two exemplary liquid absorbent sock joined in series.

25 FIG. 5 is an illustration of a detail of an exemplary liquid absorbent sock.

FIGS. 6-14 are illustrations of exemplary applications for one or more liquid absorbent socks.

30 FIGS. 15-16 are graphical representations of results of performance tests of absorbent products.

**DETAILED DESCRIPTION**

Referring now to the drawings, wherein like reference numerals designate corresponding structure throughout the views, and referring in particular to FIG. 1 there is shown a perspective view of an exemplary elongate, liquid absorbent sock 10 for collecting liquid spills and leaks. In FIG. 1, the sock 10 is partially opened up to reveal an exemplary construction. The sock includes an absorbent core of loose absorbent material 12.

The sock 10 includes a flexible, liquid permeable cover 14 enclosing the absorbent core 12. A first end 16 and a second end 18 of the flexible cover 14 are joined by a seam 20. As noted above, FIG. 1 depicts the flexible cover 14 partially opened up and having portion 22 that, when sealed, form tabs, or extensions running beyond the ends of the absorbent core 12. Referring now to FIG. 2, an adhesive layer 24 covered by a peel strip 26 (shown partially removed) is desirably included on at least a portion of the liquid permeable cover 14. It should be noted that FIG. 2 is a bottom perspective view of FIG. 1 in which the sock 10 and flexible cover 14 is partially opened up to reveal an exemplary construction.

The absorbent core 12 is formed of loose material which may be in the form of an unconsolidated batt of fibrous material, particulate materials, layers of one or more loose webs, filament or fiber tows, and combinations of one or more of these materials. If the absorbent core is in the form of an unconsolidated or loose batt of fibers, it may be formed utilizing conventional fiberizing, carding, air-forming, felting, and/or similar operations.

An adhesive seal 20 may be used to join a first edge 16 and a second edge 18 of the liquid permeable cover 14 to secure the cover around the entire structure. Of course, any suitable technique may be used to join the first edge 16 and the second edge 18 of the liquid permeable cover 14 together. Exemplary techniques include, but are not limited to, ultrasonic bonding, thermal bonding, mechanical fastening, stitchbonding, and/or combinations of the same. It is contemplated that the adhesive layer 24 and peelable strip 26 may both overlay the seam 20 instead of being on the opposite side of the sock 10 as the seam 20 as shown in FIGS. 1 and 2.

Various fibrous materials may be used to form the absorbent core. Suitable materials include, but are not limited to pulp fluff, cotton fibers, cotton linters, synthetic fibers, as well as various manufacturing waste materials that contain fibers and/or fibrous materials. These fibers may be individualized (separated into individual fibers) or combined/agglomerated in clumps.

Alternatively and/or additionally, the absorbent core may be formed of layers of loose fibrous material. These layers may be separately formed in one or more web or batt forming process and overlaid or overlapped to form the absorbent core.

The absorbent core may be formed of particulate material or may contain both fibrous material and particulate material. If both fibrous and particulate material are present, the particulate material may be distributed throughout the substantially coherent absorbent structure. The distribution of particulate material within the absorbent core may be generally uniform or the distribution may define a gradient. Alternatively and/or additionally, the

particulate material may be provided as one or more layers of the absorbent core. Suitable fibrous and particulate materials include, but are not limited to, the materials listed in TABLE 1. The bulk density and gram per gram

5 absorbency ratio for water, mineral oil, linseed oil and 30-weight non-detergent motor oil of the various materials are given.

TABLE 1

<b>Absorbent</b>	<b>Bulk Density</b>	<b>ABSORBENCY TEST (GRAM PER GRAM)</b>			
		<u>Water</u>	<u>Mineral Oil</u>	<u>Linseed Oil</u>	<u>Motor Oil</u>
Saw Dust, Treated with Oil	0.4008	0.00	0.85	0.87	0.83
Papermill Sludge, Pelletized (Owensboro - 42% inorganic)		1.92	1.10	1.29	1.29
Clay, Granular (commercial oil sorbent)	0.5283	0.50	1.41	1.24	1.41
Papermill Sludge, Flash Dried (Coleshill 50% - inorganic)	0.2022	3.18	2.28	2.97	3.16
Corn Cob, Treated with polyvinyl alcohol (New Pig™ Gray)	0.1300	7.42	3.81	4.41	4.60
Vermiculite, Treated with polyvinyl alcohol (New Pig™ Blue)	0.1270	6.38	5.31	5.47	4.86
Papermill Sludge, Flash Dried (Owensboro - 42% inorganic)	0.1726	3.80	4.35	5.32	5.53
Sphagnum Moss (Sphag Sorb®)	0.1269	0.00	5.29	5.11	5.82
Kenaf (whole stalk)	0.1488	7.86	5.23	6.26	6.41
Kenaf (core)	0.1300	8.54	5.23	6.82	6.70
Papermill Sludge, Flash Dried (New Milford - 6% inorganic)	0.0968	10.66	6.94	7.90	8.42
Fem Pad mfg. waste (Hammermilled - 1/4in screen)	0.0547	13.10	10.33	11.59	13.00
Unbonded polypropylene, fluff polyvinyl alcohol treated fill (3M Yellow)	0.0499	14.60	12.90	15.60	13.50
Unbonded polypropylene, Fluff (3M White)	0.0432	0.00	12.45	13.25	13.85
Softwood BCTMP (Creher milled from bale)	0.0524	18.19	15.15	13.94	14.47
PolyPro, Shred Treated (New Pig™ Pink)	0.0449	14.05	12.36	14.09	14.50

Table 1 - Continued

<u>Absorbent</u>	<u>Bulk Density</u>	ABSORBENCY TEST (GRAM PER GRAM)			
		<u>Water</u>	<u>Mineral Oil</u>	<u>Linseed Oil</u>	<u>Motor Oil</u>
Fem Pad (Virgin SSWK Pulp +debonder+antistat)	0.0296	23.00	12.80	14.80	16.20
Fem Pad mfg. waste (Hammermilled - 3/16in screen)	0.0496	11.23	11.22	12.50	16.56
Fem Pad mfg. waste (Hammermilled - 1/8in screen)	0.0564	13.44	12.50	13.06	16.78
Fem Pad mfg. waste (Hammermilled - 1/2in screen)	0.0525	14.36	16.19	14.52	18.30
Chopped DRC waste (cellulose and latex)	0.0394	18.20	18.76	17.31	21.14
Softwood BCTMP (Pallman milled from bale)	0.0410	19.74	16.79	20.36	23.23
Polypropylene, (3M Yellow) (cover only)	0.0412	23.90	21.70	23.30	23.90
Softwood BCTMP (never baled)	0.0259	20.30	24.70	25.00	26.00
Amino Plast (Safe Harbor™ White)	0.0110	36.00	41.00	49.00	51.00
Dust Brick (70% cellulose, 30% superabsorbent dust)	0.1770	52.45	3.60		

In some embodiments of the invention, the absorbent core may be composed of the same or different fibrous materials. It is contemplated that the absorbent core may contain multiple layers of loose material having densities and other  
5 properties different from the other layer or layers for purposes such as, for example, to enhance absorbency, to increase uptake of liquid, to improve liquid distribution, and the like. For example, each layer may be made of materials that are particularly efficient at absorbing  
10 specific types of liquids. If the absorbent core contained three layers, a top or outermost layer may be capable of absorbing large amounts of aqueous liquids, a middle or central layer may be capable of absorbing (or adsorbing) large amounts of oily liquids or non-polar liquids, and a  
15 bottom or innermost layer may be capable of absorbing and/or neutralizing caustic or acidic liquids.

In other embodiments of the invention, the entire absorbent core or simply one or more layers may be composed of or may include particulate materials. Exemplary  
20 particulate materials include, but are not limited to, clays, dusts, superabsorbents, pelletized sludge, ground corn cobs, vermiculite, and the like. The particulate materials may be selectively absorbent, selectively adsorbent, or have other desirable characteristics. Any number and configuration of  
25 layers is contemplated.

Alternatively and/or additionally, the absorbent core may include one or more webs such as, for example, meltblown webs, spunbond webs, bonded-carded webs, hydraulically entangled webs and combinations of these materials. These  
30 webs may be intact or shredded. For example, a single web may be gathered or folded to define a plurality of layers. As

another example, several webs may be layered, gathered, and/or folded to define a plurality of layers.

An important feature of the invention is that the absorbent sock is elongate. The expression "elongate" is used  
5 to mean that the absorbent sock has a length of at least about 12 inches. Desirably, the absorbent sock has a length of about 20 to 60 inches. It is contemplated that the absorbent sock could be many meters long so it may be stored on a large supply roll and cut to size for a specific  
10 application.

Generally speaking, the absorbent sock will have a "generally radial cross section." This means the plane of the cross section should have at least a generally circular, round, oblong, oval shaped, elliptical or oval cross section.  
15 Such a cross-section may have flattened sections such as, for example, at a "footprint" or base where the absorbent sock contacts the surface it is adhered or attached to.

Another feature of the present invention is that the absorbent core 12 is formed of loose material. This means the  
20 absorbent core is not generally considered to be self-supporting. The loose fibers, tow, layers of webs, granules and/or particulates are supported by a cover, jacket, sleeve which is used to define or establish the cross-section of the absorbent sock. In some embodiments of the invention, a  
25 tubular sock filled with clay particles, corn-cobs or polypropylene tow filaments or fibers utilizes the tubular sock to define or establish the cross-section of the article. In other embodiments of the invention, a tubular casing made of a thermoplastic fiber web that may be heat-molded into a  
30 shape and filled with granular solid matter utilizes the

heat-molded web to define and establish the cross-section of the article.

According to the present invention, the flexible, liquid permeable cover 14 may be any suitable material including, for example, textile materials, knit materials, nonwoven fabrics and/or films. Desirably, the cover is a nonwoven web of fibrous material. For example, the cover may be selected from spunbond webs, meltblown webs, bonded-carded webs, hydraulically entangled webs and combinations of one or more of the same. The fibrous material used to form the cover may be any suitable material. Desirably, the fibrous material is a polyolefin such as, for example, polypropylene, polyethylene, propylene copolymers, ethylene copolymers, and blends or mixtures of one or more of these materials. The cover may also be a liquid permeable film such as, for example, a slit film, an apertured film, a porous film, a microporous film, or a microapertured film. In an aspect of the invention, the nonwoven web or cover material may be apertured and/or treated to enhance liquid permeability. For example, surfactant treatments, chemical etching, burning, corona discharge treatments or the like may be used. These treatments may be used to enhance the permeability of various types of liquids, individually or collectively. For example, such treatments may be adapted to enhance the permeability of the cover to aqueous liquids, non-aqueous liquids (e.g., oils, greases, non-polar liquids), acids, bases, suspensions, emulsions, gels or the like.

As discussed above, an adhesive seal and/or mechanical fastening means may be used to join a first edge 16 and a second edge 18 of the liquid permeable cover 14 to secure the cover around the absorbent core. Conventional adhesives and

adhesive joining techniques may be readily adapted to the construction of the present absorbent sock by persons of skill in the art. Exemplary adhesives include, but are not limited to, hot-melt garment construction adhesives used in the manufacture of personal care products (e.g., diapers, incontinence products, feminine care products) such as those available under the designations: DF-5610; 434-5563; 34-5606; I34-5551; 34-5582; IL-88; 34-5561; I716; and 518-3312 from National Starch, Bridgewater, New Jersey. Other suitable hot-melt construction adhesives are available under the designation D-9105; D-3950; D-8370; JM-1004-A; and D-9105-ZP from HB Fuller, St. Paul, Minnesota. Even more suitable hot-melt construction adhesives are available under the designation L-8507; L-8007; H-2457; H-1091 from Ato Findley Inc., of Wauwatosa, Wisconsin. It is desirable that these adhesives adhere securely and have a bonding strength greater than or equal to the strength of the flexible, liquid permeable cover material.

Exemplary mechanical fastening techniques include stitching, stitchbonding, needlepunching, crimping or the like. Stitchbonding techniques are described in, for example, U.S. Patent No. 4,891,956, issued January 9, 1990, to Strack et al., the contents of which are incorporated by reference in their entirety.

In an embodiment of the invention, the cover may be made of a suitable material that can be bonded to itself by application of heat, ultrasonic energy, or an appropriate solvent so that the edges of the cover may be joined together. As an example, opposite edges of a film or nonwoven web having a thermoplastic polymer component may be joined together by applying heat and/or ultrasonic energy and

pressure so that the edges securely bond or weld together. Suitable webs and techniques are disclosed at, for example, U.S. Patent No. 5,573,841, issued November 12, 1996 to Adam et al., the contents of which is incorporated by reference in  
5 its entirety.

In one embodiment of the invention, the first and second edges of the cover are wrapped around the absorbent structure and are sealed with construction adhesive by running a bead or spray pattern along the length of one edge of the cover  
10 and overlapping or overlaying the other edge so it contacts the adhesive and forms a secure adhesive bond. The remaining unbonded, terminal portions of the cover may be joined together utilizing thermal or ultrasonic bonding techniques.

According to the invention, desirable liquid permeable  
15 cover materials having good levels of flexibility are nonwoven webs of spunbonded polypropylene filaments available from Kimberly-Clark Corporation, Roswell, Georgia. These spunbonded materials may have basis weights ranging from about 0.4 to about 4 ounces per square yard (osy). For  
20 example, these materials may have basis weights ranging from about 0.4 to about 2 osy. As another example, these materials may have basis weights ranging from about 0.6 to about 1 osy. Nonwoven webs including multicomponent spunbonded filaments (e.g., bicomponent spunbonded filaments) may be used. Such  
25 multicomponent filaments may have, for example, a sheath/core or a side-by-side configuration.

Shaped fibers including, but not limited to, bi-lobal, tri-lobal and multi-lobal fibers may be included in or may make up the cover materials when the absorbent sock is to be  
30 used for wiping, scouring, scarifying, cleaning or and for the removal of a spill or leak of a viscous, tar-like and/or

goosey substance. Lobed fibers, shaped fibers, ribbon-like fibers and fabrics incorporating the same are disclosed at, for example, U.S. Patent No. 5,498,468, issued on March 12, 1996 to Blaney, the contents of which are incorporated by  
5 reference.

Desirably, the cover will have sufficient strength so the absorbent sock can be used to wipe up liquid. For example, the cover may have desirable levels of abrasion resistance and/or tear strength so it may withstand frictional forces  
10 encountered during wiping or even scouring. This may be accomplished by utilizing a cover material such as, for example, a nonwoven web of spunbonded filaments, having sufficient basis weight and/or bonding so the cover has the required strength and abrasion resistance yet has adequate  
15 flexibility. Suitable cover materials include, but are not limited to, nonwoven webs of spunbonded filaments/fibers having a basis weight of greater than about 0.4 osy (ounces per square yard) and/or a bond surface area of greater than about 10 and about 20 percent (as determined by conventional  
20 optical image analysis techniques). Another important factor affecting the strength of the nonwoven web is the fiber/filament diameter. Desirably, the nonwoven webs include filaments/fibers have a diameter great enough to provide sufficient levels of strength while retaining desirable drape  
25 and flexibility. Desirably, the fibers/filaments have a diameter ranging from about 10 to about 60 micrometers. More desirably, the fibers/filaments have a diameter ranging from about 17 to about 35 micrometers.

In an aspect of the invention, it is desirable that the  
30 absorbent sock has a suitable level of bursting strength. That is, the strength of the flexible cover material and the

bonds joining the first edge and second edges together as well as the bonds sealing the terminal portions of the absorbent sock should be sufficient to withstand an applied force without popping open or bursting. This feature may be  
5 important if the absorbent sock is scuffed, scraped, bumped, or stepped before use, during use, or during collection for disposal. Suitable levels of bursting strength may vary depending on how the absorbent sock is to be used. Generally speaking, the bursting strength should, at a minimum, be able  
10 to withstand the peeling force of any adhesives that might be used to adhere the absorbent sock to a surface. Desirably, the bursting strength may be several times greater than the level needed to withstand the peeling force of any adhesive used to secure the absorbent sock to a surface.

15 An important feature of the present invention is that an adhesive layer is positioned on at least a portion of the liquid permeable cover. For example, the adhesive layer may be located on one or more surfaces or portions of the cover. To illustrate this point, reference is made to FIGS. 1 and 2  
20 where the adhesive layer 24 may be on the opposite side of the absorbent sock 10 as the seam 20 created by joining the first edge 16 and second edge 18 of the flexible, liquid permeable cover 14. Alternatively, the adhesive layer 24 may be on the same side of the absorbent sock 10 as the seam 20  
25 created by the edges of the flexible cover 14. When the adhesive layer utilizes an active or tacky adhesive, a peel strip may be used to cover the adhesive until the adsorbent sock is ready to be applied to a surface. Generally speaking, the peel strip may be any paper, plastic or similar sheet  
30 material which is releasable from the adhesive. The peel strip may be coated or impregnated with a conventional

release agent so it may be removed without damaging the adhesive.

The present invention encompasses embodiments of the absorbent sock having adhesive layers or strips at a plurality of locations on the sock. For example, adhesive layers may be positioned on both the top and bottom portions of the absorbent sock, one or both sides of the absorbent sock and/or any combination thereof. According to the invention, the adhesive layer may be a continuous layer or it may be discontinuous. The adhesive may be applied in any configuration including a continuous bead, various spray patterns, splatterings, printings, swirl arrangements or the like.

Desirably, the adhesive layer is a pressure sensitive adhesive layer. Suitable pressure sensitive adhesives include, but are not limited to, hot-melt "garment" adhesives of the type applied to personal care products (e.g., feminine care products, incontinence products, etc.) to adhere the product to the garment of a wearer. As an example, useful hot-melt garment adhesives include those available under the designations 34-5602 (also known as "Easy Melt"); DF-5575; 170-3902; DM-523; 34-5516; 34-5512; MQ 7987; 53-4503 from National Starch, Bridgewater, New Jersey. Other useful hot-melt garment adhesives include those available under the designations HL-8141; D-58; D-3944; HL-8112; HM-5717; HL-1375; and HM-1972 from HB Fuller, St. Paul, Minnesota, and the adhesive available under the designation 910-373 from Ato Findley, Inc., of Wauwatosa, Wisconsin.

In embodiments of the invention, the garment adhesives should provide a level of adhesion that is less than the bond strength of the seam which joins the first edge and the

second edge 18 of the cover material 14 together. While the level of adhesion may be varied and adjusted greatly, in some embodiments it is desirable that the "garment" adhesives provide a level of adhesion that may be measured in the range of about 20 to about 1000 grams for a cotton fabric or nylon fabric substrate generally in accordance with ASTM E 171-87. For example, the "garment" adhesives desirably provide adhesion in the range of about 100 to about 500 grams. Even more desirably, the "garment" adhesives provide adhesion in the range of about 200 to about 400 grams.

In embodiments of the invention, the adhesive layer may be in the form of a strip of adhesive running along the length of the flexible cover. The adhesive layer may run along the entire length dimension of at least one side of the cover.

The adhesive strip may have a width ranging from almost equal to the width of the cover to a relatively thin strand or bead. Generally speaking, the adhesive strip may have a width sufficient to provide good adhesion of the adsorbent sock to surfaces in view of the peel strength or tack of the adhesive. For example, some suitable pressure sensitive adhesives of the type used in self-sealing envelopes and the like can be applied in a strip having a width ranging from about 1 inch to about one-quarter of an inch. Another feature of the invention is that when the adhesive strip on the flexible cover material is used to secure the absorbent sock to a surface, the adhesive strip and flexible cover material are adapted to conformably and securely contact the surface. This tight contact generates a seal, barrier or block to minimize gaps, spaces, capillaries and the like and reduces leakage of liquid past the absorbent sock.

The adhesive layer should provide satisfactory adhesion of the adsorbent sock to vertical surfaces, horizontal surfaces, curved surfaces, flat surfaces or surfaces having irregular topography and/or extreme temperature.

- 5 Alternatively and/or additionally, the adhesive layer should provide satisfactory adhesion so the sock may adhere to flexible surfaces, moving surfaces, reciprocating surfaces, vibrating surfaces and the like. These surfaces may be encountered in a variety of forms such as, for example, a
- 10 floor, a wall, a ceiling, a section of a machine, pipe or tank, another absorbent sock, or a device for wiping up spills and/or surface contamination (e.g., grime and goo). These surfaces may also include drive shafts, transmissions, differential gear housings, reservoirs/oil pans/sumps for
- 15 motors or motor vehicles. While these surfaces are predominantly non-porous surfaces, it is contemplated that the adhesive layer could be configured to provide acceptable levels of adhesion to surfaces having some porosity.

- It is contemplated that the adhesive layer may
- 20 supplemented by or replaced with other fastening systems such as, for example, mechanical fastening systems. Exemplary mechanical fastening systems include Velcro® hook and loop fasteners, eyes and hooks, snaps, strings, magnetic strips or the like. In one embodiment of the invention, it is
- 25 contemplated that the flexible, liquid permeable cover may be formed from or include sections of a loop material suitable for a hook and loop fastening system. An exemplary material is disclosed in U.S. Patent No. 5,669,900, issued on September 23, 1997 to Bullwinkel et al., the contents of
- 30 which are incorporated herein by reference. The hook material may be affixed to a surface, machine, tool or article and the

absorbent sock may be attached by interaction of the hook and loop portions of the fastening system. Such a system may be used alone or in conjunction with the adhesive layer.

In an aspect of the present invention, the flexible,  
5 liquid permeable cover has portions forming tabs that extend beyond the absorbent core. This feature is illustrated in FIG. 3, which depicts an absorbent sock 10. The end of the absorbent core 12 is indicated by the seam 40 shown as broken lines. A terminal portion 50 of the flexible cover 14 can be  
10 seen extending beyond the seam that defines the end of the absorbent core 12. According to the invention, the length of the terminal portion 50 is desirably great enough so that two or more absorbent socks may be joined in series by adhering the terminal portion of one sock to a terminal portion of the  
15 cover on an adjacent sock. An illustration of this configuration may be seen in FIG. 4 wherein a first absorbent sock 10 and a second absorbent sock 10' are joined in abutting relationship by overlapping the terminal portions 50 and 50'. The absorbent socks may be joined in many other  
20 configurations such as, for example, joining the terminal portion of the cover of one sock to a non-terminal portion of the cover of another sock to form a "Y", "T", "E" or similar pattern.

This ability to be joined in series or in various  
25 patterns provides advantages over previous absorbent products used to absorb industrial leaks and spills because the adhesive layer on the socks generates a tight seal that minimizes leakage and reduces or eliminates the need to overlap, stack or stagger extra absorbent products to catch  
30 the liquid that leaks through the locations where the absorbent products connect or through areas where gaps,

spaces or capillaries are formed. This permits more efficient and economical use of the absorbent socks. Also, using fewer socks tends to reduce the amount of material to be disposed and, in some cases, the disposal costs.

5       The terminal portion of flexible cover may also be used to create a seal between the terminal portion of an absorbent sock and an adjacent wall or structure as illustrated in FIG. 5. In particular, FIG. 5 shows an absorbent sock 10 on a first surface 52 and in abutting relationship with a second  
10       surface 54 that intersects the first surface 52. The absorbent sock 10 is shown adhered to the first surface 52 and the terminal portion 50 of the absorbent sock 10 is adhered tightly to the second surface 54 to create a seal or barrier to liquid. Such a seal or barrier can be used to  
15       direct liquid, control liquid flow, impound liquid, as well as to hold liquid so that it can be absorbed by the absorbent sock.

      The present invention also encompasses a method or system for controlling liquids and/or collecting liquid leaks and  
20       spills. The system involves:

      (1) providing an elongate, liquid absorbent sock including:

              a liquid absorbent core of loose absorbent material;

25       a flexible, liquid permeable cover containing the loose absorbent material and establishing the cross-section of the sock, and;

              an adhesive layer on at least a portion of the liquid permeable cover; and

30       (2) securing the elongate, liquid absorbent sock to a surface utilizing the adhesive layer so that the liquid

absorbent sock is configured to collect liquid leaks and spills.

The system includes securing the elongate, liquid absorbent sock to another elongate, liquid absorbent sock utilizing the adhesive layer. The system also includes securing the elongate, liquid absorbent sock to a device for wiping up liquid.

The elongate, liquid absorbent sock may be used in a variety of configurations in the practice of the present invention. For example, FIG. 6 is an illustration of an exemplary absorbent sock 10 adhered around a vertical pipe 60 so it is configured to collect liquid leaking from a valve 62. FIGS. 7A and 7B are illustrations of multiple absorbent socks 10 ganged or adhered together to function as a substitute for a drip pan. In particular, FIG. 7A is shows multiple absorbent socks 10 adhered together in parallel. FIG. 7B shows multiple absorbent socks connected in series and coiled radially. A first sock 10' at the center is adhered to itself to form a coil. Another sock 10'' is adhered to the terminal portion and circumference of the first sock and then to itself as it is wrapped around to form a larger coil. Yet another sock 10''' is adhered to the coil to form an even larger coil. FIG. 8 is an illustration of an exemplary absorbent sock 10 adhered around a horizontal pipe 64 so it is configured to collect liquid leaking from a pipe. Such leaks may appear at, for example, pipe joints. For purposes of the present invention, the horizontal pipe 64 in FIG. 8 is also representative of a rotating drive shaft, reciprocating shaft, vibrating shaft, flexible shaft, or other moving, vibrating, or rotating component or device. As discussed above, the absorbent sock may be adhered to such

moving or movable items. FIG. 9 is an illustration of an exemplary absorbent sock 10 applied to the base of a machine 66 to absorb leaks. The absorbent sock may be adhered to the base or the sock may be positioned at the base of the machine without using the adhesive. As discussed above, the present invention encompasses absorbent socks which may be used without engaging the adhesive strip or which even lack an adhesive strip. The absorbent sock may also be adhered to the underside of a machine, to a moving element or component of a machine, or to other locations where conventional absorbent products without the adhesive strip would be dislodged or thrown off.

FIG. 10 is an illustration of exemplary absorbent socks 10 adhered to a work bench or working surface 68 to absorb spills. FIG. 11 is an illustration of exemplary absorbent socks 10 applied to a floor or other flat surface 70 to control a spill 72. In this embodiment, absorbent socks may be adhered to the floor or the socks may be positioned on the floor without using the adhesive. As discussed above, the present invention encompasses absorbent socks lacking an adhesive strip or socks which may be used without engaging the adhesive strip. FIG. 12 is an illustration of exemplary absorbent socks 10 applied to the exterior of a container 74 to absorb spills, splashes, or to absorb condensation which might appear on a cool or chilled container under certain conditions such as, for example, high humidity. The exemplary absorbent socks applied to a container in this manner may also be used to cushion or protect the container.

FIG. 13 is an illustration of an absorbent sock 10 adhered to an exemplary device 76 for wiping up liquids. The device 76 may be, for example, a simple "T" stick having a

handle 78 and a head 80 to which one or more absorbent socks may be adhered. It is contemplated that in this configuration, the absorbent sock could also be used to apply liquids, to apply or remove particulate materials (e.g.,  
5 dust, powders, etc.), and the like.

FIG. 14 is an illustration of an exemplary absorbent sock folded back on itself and adhered into position utilizing the adhesive layer so it can be used as a wad or very high capacity wiping product or liquid applicator product. In this  
10 embodiment, the absorbent sock may be hand-held. In other embodiments, the absorbent sock may be ganged together for use or may be ganged together for attachment to a stick or device for wiping-up or applying liquid.

Certain features and characteristics of exemplary  
15 absorbent socks of the present invention are illustrated by the following examples. It should be understood that these examples are illustrative only.

#### **Dynamic Performance Test for Absorbent Liquid and Spill**

##### **20 Control Products**

Various absorbent products were tested to simultaneously measure their ability to 1) absorb a challenge liquid (e.g., oil, acid, caustic, solvent, coolant emulsion, etc.); and 2) control or hold back a constant height of that liquid. The  
25 test was designed to simulate a real-world industrial spill situation.

In each test, the absorbent product was placed in a test tray which simulated a channel or trough. The absorbent product was laid across the open end to block the passage of  
30 liquid while being subjected to a constant height or head of liquid. Liquid leaking past the absorbent product was

collected in a leakage collection tray. The rate of absorption was determined by measuring the change in the weight distribution of liquid in the testing device and applying appropriate calculations. The rate of leakage past the absorbent sock was determined by measuring the change in the weight of liquid in the leakage collection tray.

### Apparatus

Tests were conducted using a test tray having three fixed walls about 3 inches high and one open end with an adjustable/retractable wall. Absorbent products were laid across the open end of the tray. If necessary, the adjustable/retractable wall was used to accommodate the various sizes of absorbent products tested. Products tested ranged from about 20 inches to 50 inches in length. The bottom and back of the retractable wall was lined with rubber to prevent fluid leakage. The test tray was made of inert plastic, but other materials such as concrete or metal could be used to simulate different spill surface conditions.

The tray was twenty-four inches long by about fifty inches wide. Its generous size provided a large reservoir area to accommodate rapid fluid absorption with minimal changes in the challenge liquid height ( $\Delta h$ ).

In each test, an absorbent product was placed along the open end of the tray. Prongs protruding from the open end of the tray and the side walls prevented the absorbent product from moving if the product was not constrained by adhesive or mechanical fastening. To prevent preliminary fluid absorption, a thin plastic film (e.g., SARAN® wrap) was draped across the absorbent product and secured against the

test tray side walls until the test tray filled to the challenge height ( $\Delta h$ ) with liquid.

A piece of metal was attached to the base of the test tray across the entire open end to deflect liquid leaking  
5 past the absorbent product into a leakage tray. This piece of metal extended from the base of the test tray at a 45 degree angle and for a length of about one inch toward the leakage tray.

During each test, the test tray rested on a pivot frame  
10 at approximately the center of gravity of the test tray. The pivot frame consisted of two sheets of metal joined together to form an "A" frame having a rounded, rather than pointed, apex.

The front end of the test tray rested on top of a dome  
15 (half-sphere) which, in turn, rested on an electronic balance (BALANCE A) that continually recorded the load applied to the front end of the test tray. The balance is set on a lab jack such that the height of the balance can be adjusted to ensure that the test tray is level prior to running a test. The  
20 initial loading on the balance is modified by changing the distance from the pivot frame to the balance.

The electronic balance was a Metler Balance (Model PM 4600) with RS232 output connected to a computer that recorded all data. The balance was zero-deflection balance such that  
25 as a load is applied to the balance top, an inductive coil within the balance exerts a reverse force on the balance top. Thus, despite an increase in load, the height of the balance top remains unchanged and there is no deflection in the downward direction. This is critical for maintaining the  
30 test tray constantly level during the test procedure so the electronic balance only registers a change in weight due to

liquid absorbed by the absorbent product. That is, the electronic balance reading increases as the as the absorbent product absorbs liquid.

5 An airtight container was used to contain a reservoir of challenge fluid. The container was positioned in the center of the test tray and was designed to maintain a constant height of fluid in the test tray during a test. This was accomplished using an adjustable breather tube. One end of the breather tube extended from an airtight port at the top  
10 of the airtight container and the other, open end was mounted on a bracket to be at the desired challenge liquid height ( $\Delta h$ ). At the beginning of a test, liquid poured out of a small opening at the bottom of the airtight container. The small opening was eventually covered up by the liquid in the  
15 test tray. After this occurred, liquid in the airtight container could exit the airtight container (and into the test tray) only if liquid was replaced by air drawn in through the breather tube. Once the level of liquid in the test tray reached the open end of the breather tube and  
20 prevented air from being drawn into the airtight container, liquid flow stopped. As liquid was absorbed by the absorbent product sample or leaked into the leakage tray, the liquid level in the test tray slightly lowered to uncover the open end of the breather tube. This simple control mechanism kept  
25 the liquid level in the test tray relatively constant.

Liquid flowing past the absorbent products is directed by the metal deflector into a leakage tray. A small tray having dimensions of about 28 inches by 1 inch was used for short absorbent products. A large leakage tray having dimensions of  
30 about 50 inches by 2 inches was used for long absorbent products. The short tray rested directly on a second

electronic balance (BALANCE B) attached to a computer that recorded data so the weight of fluid in the tray could be measured directly. BALANCE B was a Metler balance similar to BALANCE A. The large tray rested on a fulcrum and an  
5 electronic balance so appropriate equations were needed to calculate the weight of liquid in the leakage tray.

### Test Procedure

The open or leakage edge of the test tray was aligned  
10 parallel to the axis of the pivot and the test tray was leveled in both the length and width dimensions. The level tray was moved until about 100 to 150 grams registers on electronic balance. The objective was to create a level tray that has a slight loading on the balance.

15 Next, the test sample was weighed to obtain the dry weight (to the nearest tenth gram). The open end of the test tray was adjusted to a length less than the test samples' advertised length. For example, one product having an advertised length of 42 inches (~107 cm) was tested using a  
20 100 cm length opening at the open or leakage end of the test tray.

The test sample was placed so its edge was in contact with the open edge of the test tray and the length dimension of the sample is parallel to the pivot. The ends of the test  
25 sample were compressed and adjusted by hand to provide the tightest fit against the vertical surfaces of the test tray. Samples having adhesive attachment means were tested using the adhesive to secure the sample against the vertical surfaces and along the open end of the test tray. Samples  
30 having loose filler material were adjusted to obtain a

relatively uniform distribution of material along the length and at the ends of the sample.

The distance (**d1**) between center of a test sample (e.g., centroid of a tubular/cylindrical test sample) and the pivot point or line was recorded. The distance (**d2**) from the contact point of the balance under the test tray and pivot point or line was recorded.

A thin plastic film (e.g., SARAN® wrap) was placed over the length of the test sample to keep it from contacting the challenge liquid while the tray filled. This was accomplished by folding a piece of the plastic film along its center line to cover a 4 inch wide piece of cardboard cut to a length equal to the length of the tray opening. The film extended beyond the length of the cardboard by about 6 inches at each end.

The folded edge of the film-covered cardboard was laid along and against the bottom of the challenge/inboard side of the test sample. The lower flap of the folded film was pressed firmly against the tray surface to form a seal. The upper flap of the film was unfolded to cover the challenge/inboard side of the test sample creating a continuous barrier between the test sample and the liquid in the test tray until the film was removed. The cardboard was used to ensure full snug contact along the full length of the test sample. The extra length of film at each end of the cardboard was used to seal both vertical edges of the test tray.

A leakage tray was positioned along and below the full length of the test sample just behind the leakage deflector. The leakage tray was placed directly upon a second electronic

balance if the test sample was expected to allow only a slow rate of leakage.

In cases where a rapid rate of leakage was expected, a fulcrum and balance setup was used. This fulcrum and balance arrangement was similar to that used for the test tray. The distance (d3) from the center of gravity of the leakage tray to the fulcrum and the distance (d4) from the center of gravity of the leakage tray and the balance were measured and noted.

The level of the test tray was checked and the electronic balance settings were noted. A container(s) of challenge liquid was placed in the tray so that its center of gravity was directly over the pivot line. The breather tube was set at the desired height above the surface of the test tray. Plugs in the challenge liquid containers were removed and the challenge liquid flooded the test tray.

Final adjustment to the level of the test tray were made and the electronic balance was allowed to stabilize. A balance reading was taken and was recorded as the "zero absorbed condition" for the test sample.

The computer program for recording data from the balance under the test tray and the balance under the leakage tray was started. The plastic film cover was removed lifting it vertically at each end of the test sample in a quick motion. Challenge liquid flooded against the ends of the test sample and quickly moved to the sample center. If necessary, a slight temporary pressure was applied to keep the plastic film from lifting the test tray as the film was removed. Any excess liquid on the plastic film was quickly returned to the test tray. This entire step requires about 5 to 10 seconds.

As challenge liquid is absorbed by the test sample the weight measured by balance under the test tray (balance "A") increases. This increase can be expressed by the following equation:

5

$$(d2/d1) * (\text{Balance A reading} - \text{Initial Balance A reading})$$

Liquid that escapes the test sample is collected into the leakage tray and is represented by an increase in the reading on balance B. For test samples having a rapid rate of leaking (see, for example FIG. 20), this weight can be expressed by the following equation:

10

$$[(d3 + d4)/d3] * (\text{Balance B reading} - \text{Balance B initial reading})$$

15

For test samples having a slow rate of leaking, the weight can be expressed simply as (Balance B reading - Balance B initial reading).

Each test continued until: 1) the leakage tray was filled with liquid approximately equal to or greater than 125% of the test sample's rated capacity (e.g., 125% or 64 ounces for the gray 42-inch "original" Pig™, available from New Pig®, Tipton, PA); or 2) the rate at which liquid leaked past an absorbent sample equaled or exceeded the rate at which the sample absorbed liquid. The rates are measured approximately by timing the change in the two balance readings over 20 seconds.

20

25

The tests were stopped by preventing liquid from flowing out of the airtight container and then quickly removing the test sample and weighing it to confirm the accuracy of the electronic measurements. The sample was removed by holding

30

it approximately horizontal to avoid excess leakage from it which would occur if it were to be held in vertically or if folded. Adhesively secured test samples were removed using care to avoid squeezing the test sample while detaching it  
5 from the test tray.

Electronic data and other measurements were used to plot a time history of the test sample performance when subjected to the challenge liquid at a constant height. Time was plotted on the X-axis and the quantity of liquid  
10 absorbed/leaked was plotted on the Y-axis. Initial readings from the balances are used to establish the "zero absorbed" and "zero leaked" condition at "time zero". Results of the tests are shown in FIGS.15 and 16.

FIG. 15 is a graphical representation of the test  
15 results of an oil sorbent sock described as the "Petroleum Sorbent Boom" available from Minnesota Mining & Manufacturing Corporation (3M), St. Paul, Minnesota. The product had a white outer cover, measured 48 inches in length by 3.5 inches in diameter, and was filled with polypropylene fiber tow. The  
20 challenge liquid was 30 weight non-detergent motor oil at a challenge head or height of 13 mm. Various leak zones appeared along the length of the oil sorbent sock during testing.

FIG. 16 is a graphical representation of the test  
25 results of an oil sorbent sock described as the "Petroleum Sorbent Boom" available from Minnesota Mining & Manufacturing Corporation (3M), St. Paul, Minnesota. The product had a white outer cover, measured 48 inches in length by 3.5 inches in diameter, and was filled with polypropylene fiber tow. A  
30 48 inch long by 1 inch wide double-sided tape (3M tape #948) was applied over the entire 48 inch length of the oil sorbent

sock. The challenge liquid was 30 weight non-detergent motor oil at a challenge head or height of 15 mm.

5 The test was started and leakage immediately occurred at one end of the test specimen where an imperfect seal had been made against the end wall of the tray. This leak persisted for the entire test and was the source of virtually all the leaked fluid. The other end of the test specimen formed a good seal with the opposite end wall of the tray and began leaking only after about 10 minutes into the test. Other than 10 these two leaks at the interface between the end walls of the tray and the test specimen, no leaks appeared over the remaining length of the test specimen. The test was terminated when the leakage tray was filled to capacity with leaked oil - which was before the sock had reached its rated 15 capacity. It appeared that the adhesive strip applied to the sock closed all the leaking zones that had occurred in the test of an identical oil sorbent sock without the adhesive strip.

FIG. 15 indicates that the oil sorbent sock without the 20 adhesive leaked approximately 1750 grams of oil in less than 10 seconds. In contrast, FIG. 16 indicates that the addition of the adhesive strip to the sock reduced the leakage rate so that it took approximately 32 minutes for 1750 grams of oil to leak past the sock.

25 It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes 30 may be made in detail, especially in matters of shape, size and arrangement of parts within the principles of the

invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

**WHAT IS CLAIMED IS:**

1. An elongate, liquid absorbent sock for handling liquids, the sock comprising:

a liquid absorbent core of loose absorbent material;

5 a flexible, liquid permeable cover containing the loose absorbent material and establishing the cross-section of the sock, and;

an adhesive layer on at least a portion of the liquid permeable cover.

10

2. The elongate, liquid absorbent sock of claim 1, wherein the sock has a generally circular cross section.

3. The elongate, liquid absorbent sock of claim 1,  
15 wherein the loose liquid absorbent material comprises a fibrous material.

4. The elongate, liquid absorbent sock of claim 1,  
wherein the loose liquid absorbent material comprises a  
20 particulate material.

5. The elongate, liquid absorbent sock of claim 1,  
wherein the loose liquid absorbent material comprises fibrous  
and particulate materials.

25

6. The elongate, liquid absorbent sock of claim 1,  
wherein the cover is a nonwoven web of fibrous material.

7. The elongate, liquid absorbent sock of claim 6,  
30 wherein the nonwoven web is selected from spunbond, meltblown bonded carded webs and combinations thereof.

8. The elongate, liquid absorbent sock of claim 6, wherein the nonwoven web is apertured.

5        9. The elongate, liquid absorbent sock of claim 6, wherein the fibrous material is formed of a polyolefin.

10. The elongate, liquid absorbent sock of claim 1, wherein the cover is treated to enhance liquid permeability.

10

11. The elongate, liquid absorbent sock of claim 1, wherein the cover has sufficient strength so the absorbent sock can be used to wipe up liquid.

15        12. The elongate, liquid absorbent sock of claim 1, wherein the cover forms flexible extensions at least at one end of the sock.

13. The elongate, liquid absorbent sock of claim 1,  
20 wherein the adhesive layer is substantially continuous.

14. The elongate, liquid absorbent sock of claim 1, wherein the adhesive layer is substantially discontinuous.

25        15. The elongate, liquid absorbent sock of claim 1, wherein the adhesive layer is a pressure sensitive adhesive layer.

16. The elongate, liquid absorbent sock of claim 1,  
30 wherein the adhesive layer is adapted to secure the absorbent sock to a surface.

17. The elongate, liquid absorbent sock of claim 1, wherein the adhesive layer is adapted to secure the absorbent sock to another absorbent sock.

5

18. The elongate, liquid absorbent sock of claim 1, wherein the adhesive layer is adapted to secure the absorbent sock to a device for wiping up liquid.

10 19. A system for collecting liquid spills and leaks comprising:

providing an elongate, liquid absorbent sock comprising:  
a liquid absorbent core of loose absorbent material;

15 a flexible, liquid permeable cover containing the loose absorbent material and establishing the cross-section of the sock, and;

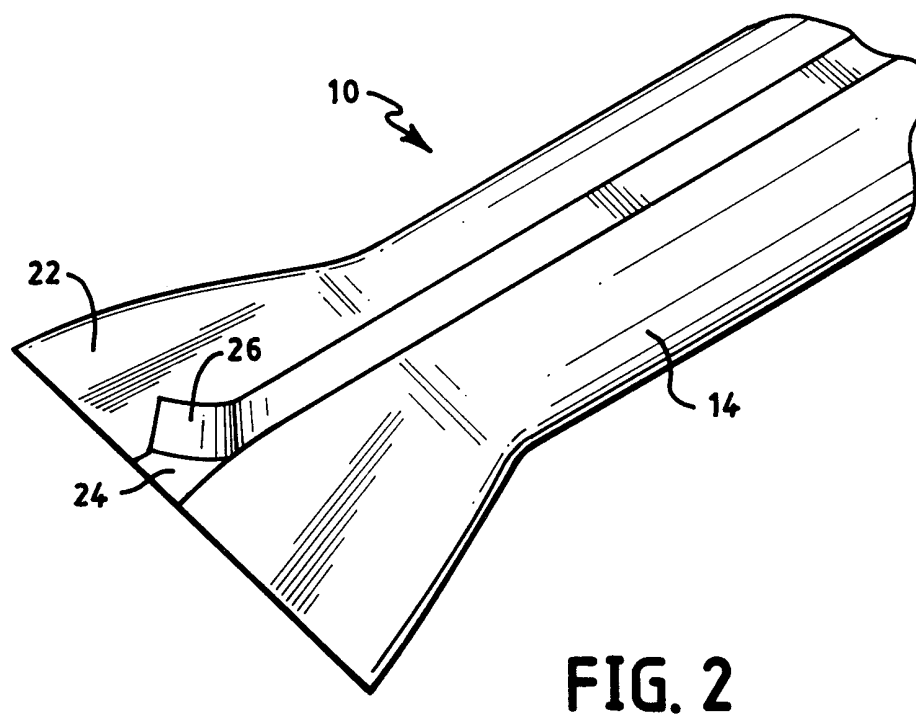
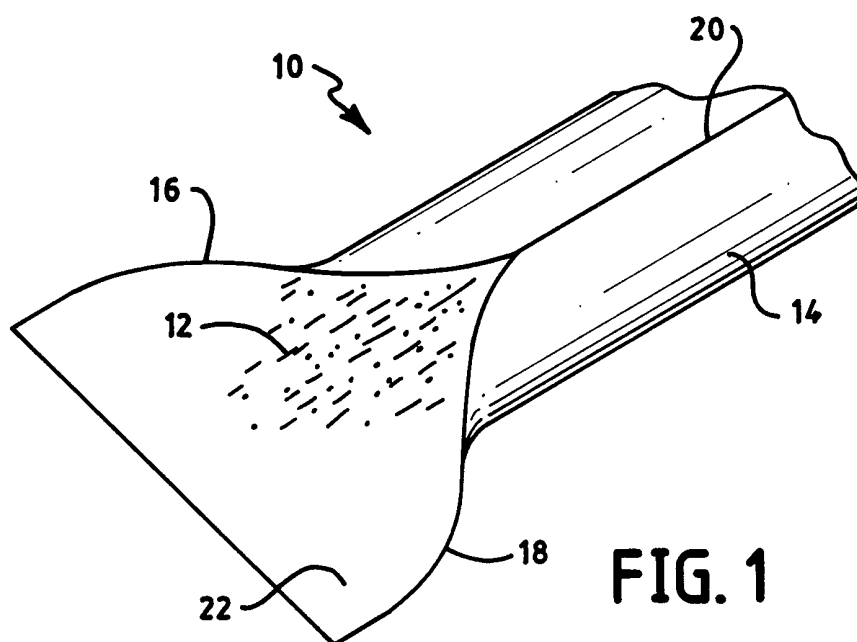
an adhesive layer on at least a portion of the liquid permeable cover; and

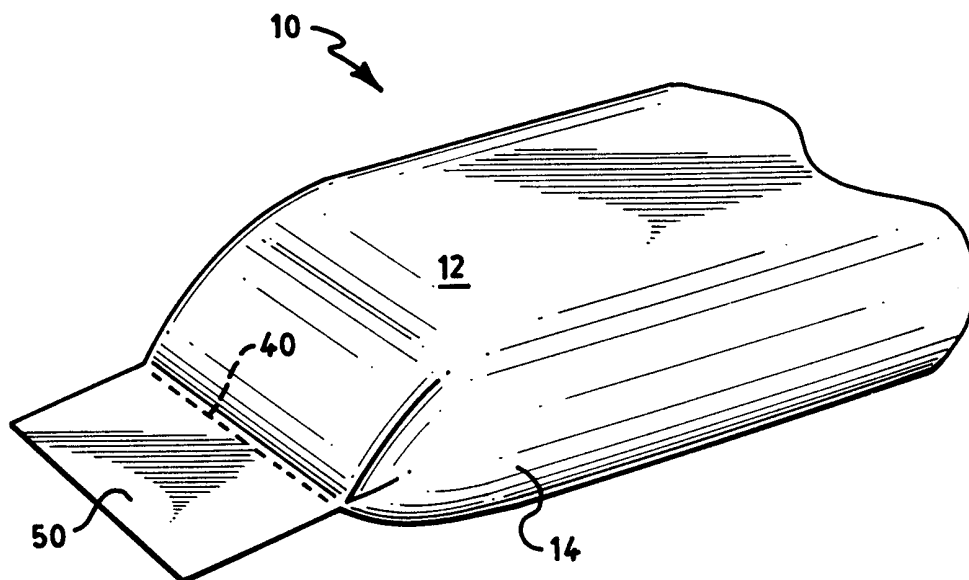
20 securing the elongate, liquid absorbent sock to a surface utilizing the adhesive layer so that the liquid absorbent sock is positioned to collect liquid leaks and spills.

20. The system of claim 19, wherein the elongate, liquid  
25 absorbent sock is secured to another elongate, liquid absorbent sock utilizing the adhesive layer.

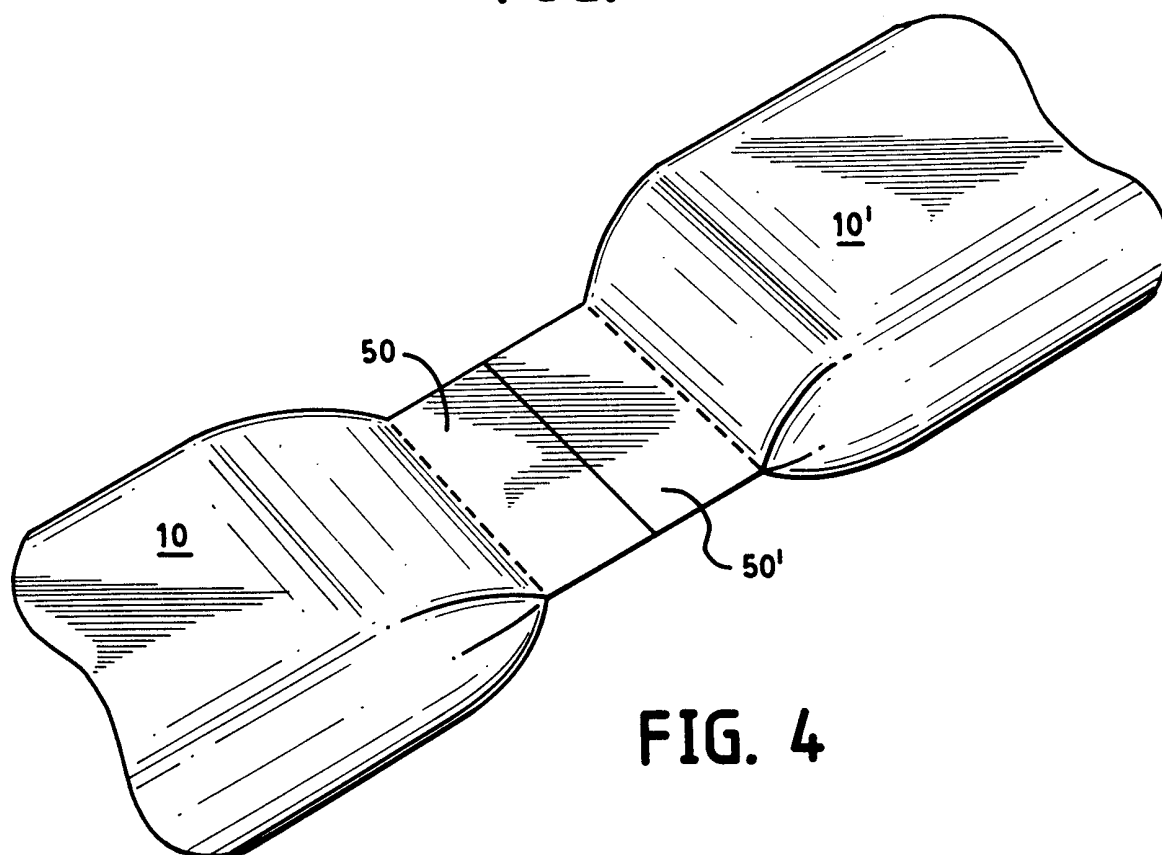
21. The system of claim 19, wherein the elongate, liquid absorbent sock is secured to a device for wiping up liquid.

30





**FIG. 3**



**FIG. 4**

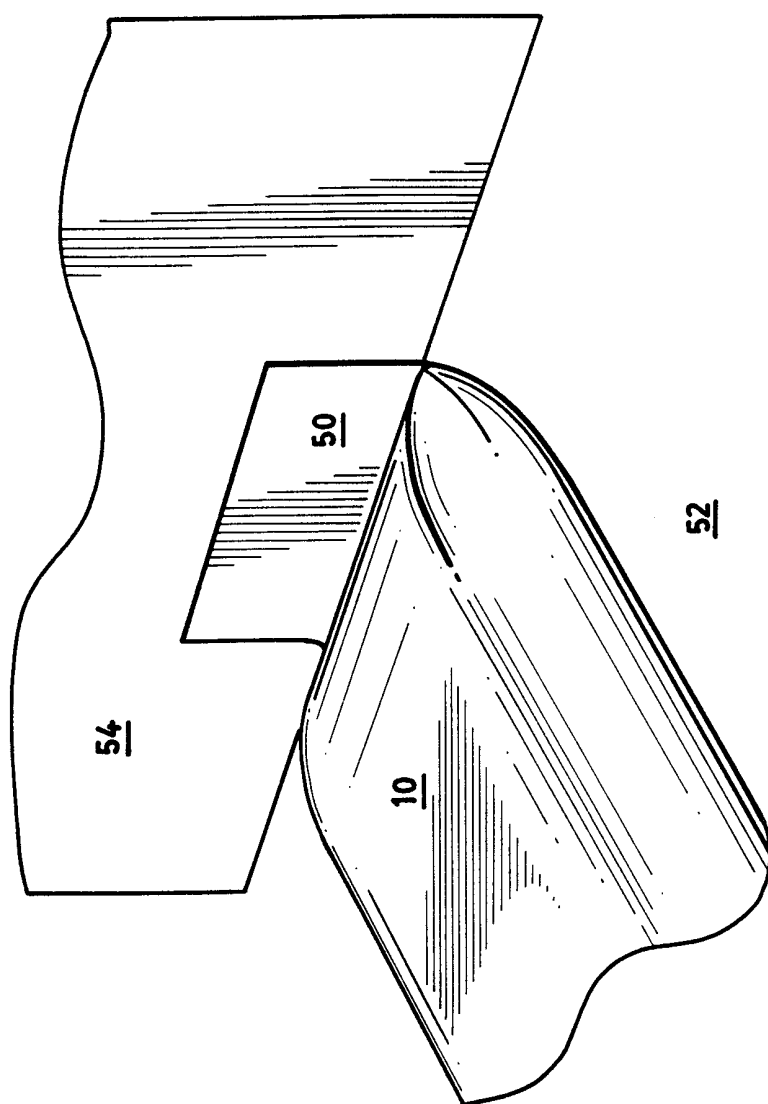
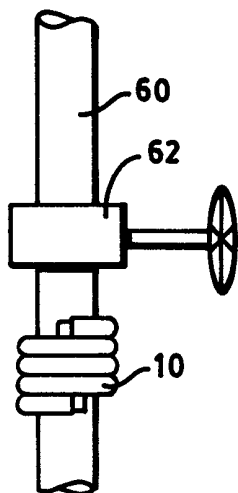
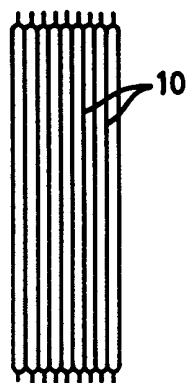


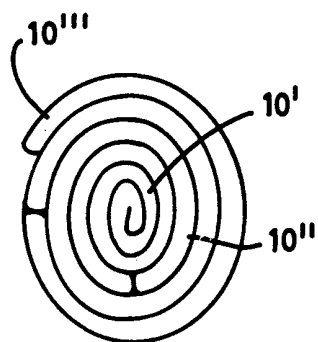
FIG. 5



**FIG. 6**



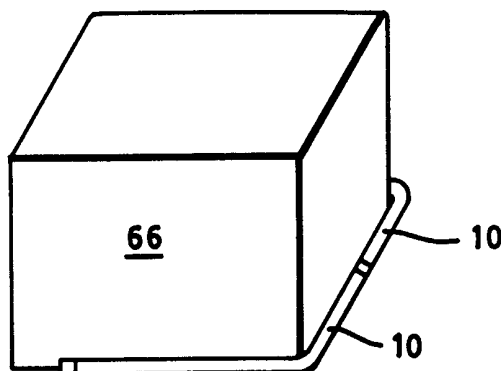
**FIG. 7A**



**FIG. 7B**



**FIG. 8**



**FIG. 9**

5 / 8

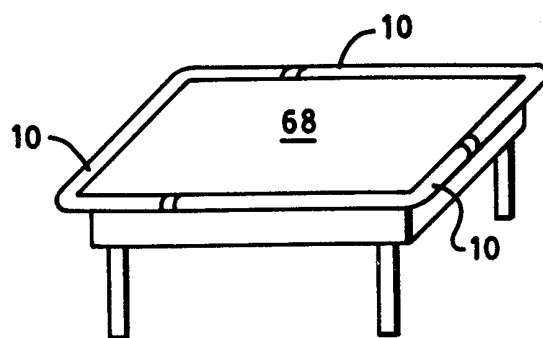


FIG. 10

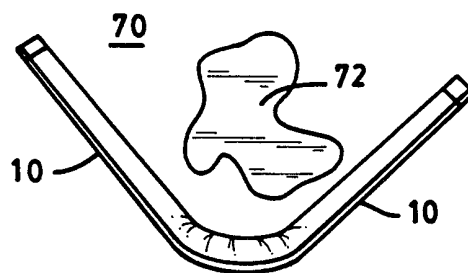


FIG. 11

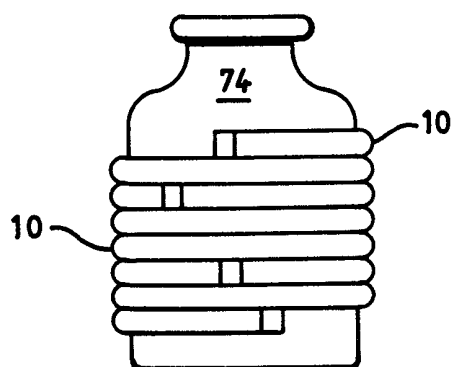


FIG. 12

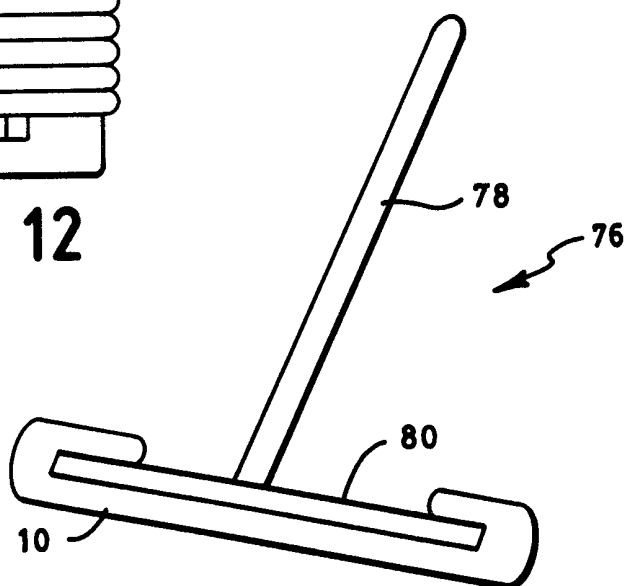
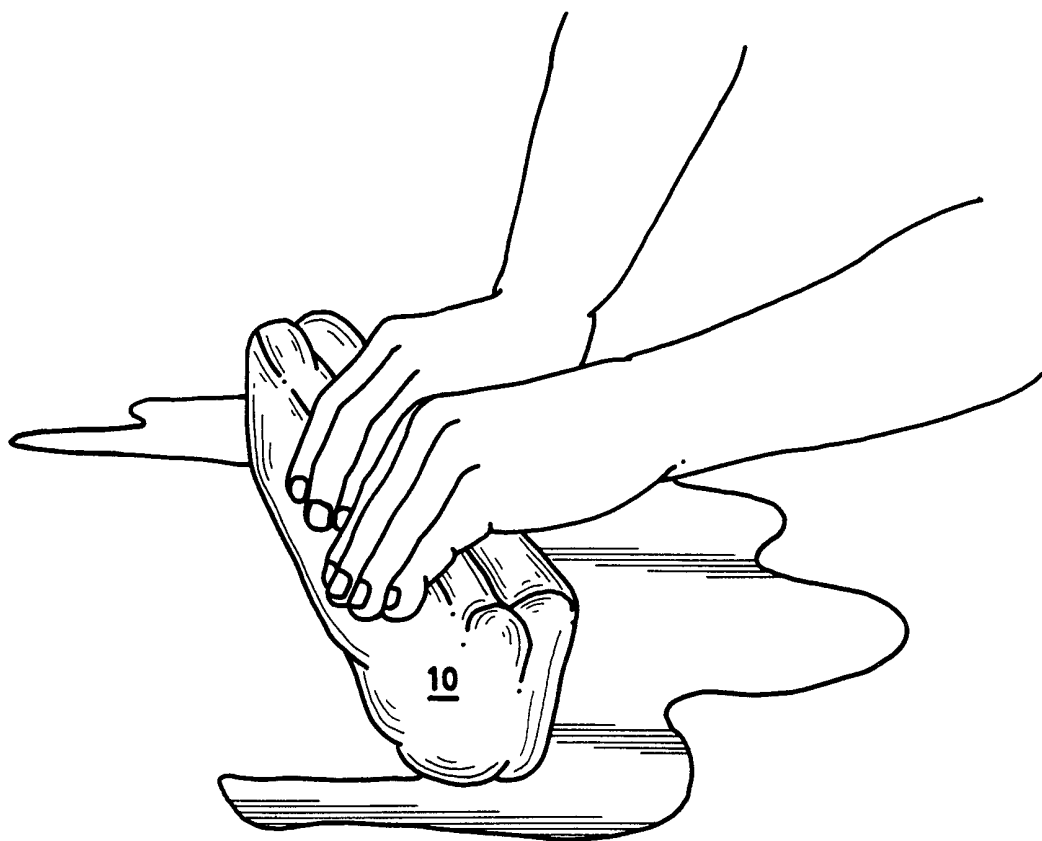


FIG. 13



**FIG. 14**

7 / 8

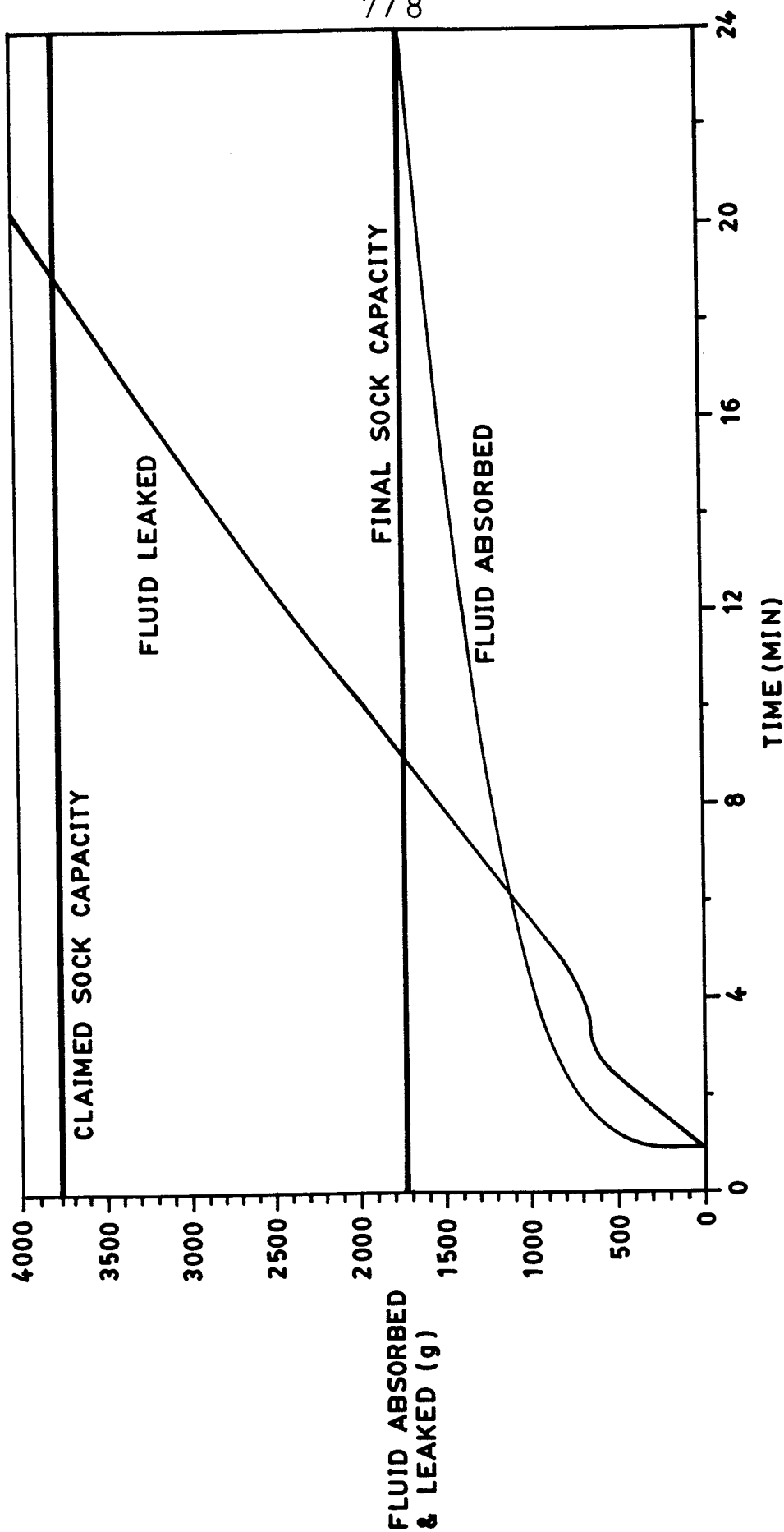


FIG. 15

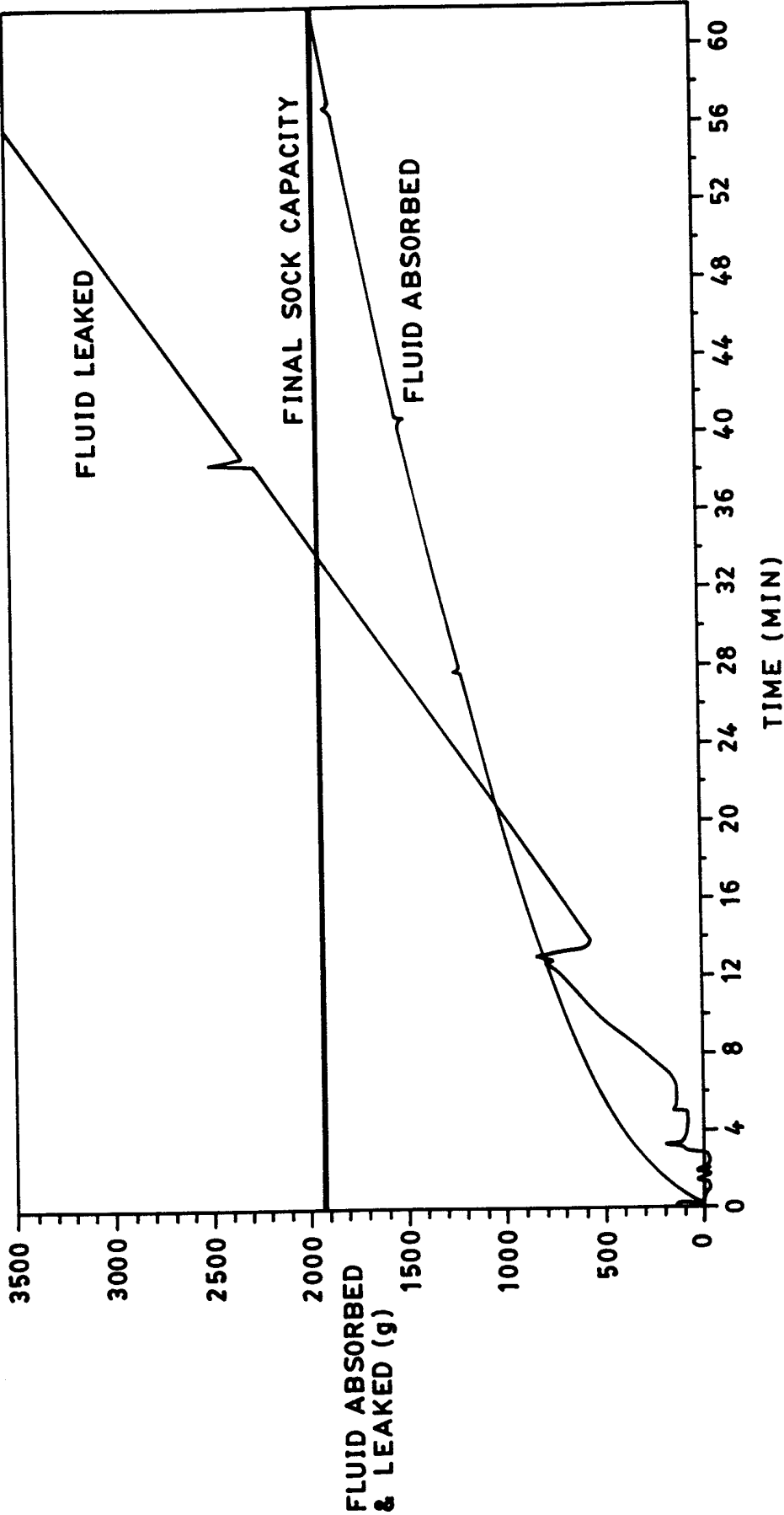


FIG. 16

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 99/12013

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC 6 A47L13/16		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) IPC 6 A47L B32B E04H F16N E04B F16L A61F C02F		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used)		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	WO 99 05956 A (KIMBERLY CLARK CO) 11 February 1999 (1999-02-11) the whole document ---	1-21
A	WO 93 07090 A (HILL ALAN R) 15 April 1993 (1993-04-15) page 9, line 26 -page 10, line 20 page 11, line 22-32 figures 3,5,6 ---	1-3,6,8, 12,19
A	WO 97 37757 A (KIMBERLY CLARK CO) 16 October 1997 (1997-10-16)  page 5, line 11-21 page 7, line 10-24 page 9, line 1-31 page 10, line 29 -page 11, line 18; figures 7-9 --- <div style="text-align: right;">-/--</div>	1,2,6-9, 12,17, 19,20
<div style="display: flex; justify-content: space-between;"> <span><input checked="" type="checkbox"/> Further documents are listed in the continuation of box C.</span> <span><input checked="" type="checkbox"/> Patent family members are listed in annex.</span> </div>		
* Special categories of cited documents :		
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p> </div> </div>		
Date of the actual completion of the international search  <div style="text-align: center;">29 September 1999</div>		Date of mailing of the international search report  <div style="text-align: center;">11/10/1999</div>
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer  <div style="text-align: center;">Laue, F</div>

# INTERNATIONAL SEARCH REPORT

Int: 'tional Application No

PCT/US 99/12013

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>US 5 135 521 A (LUCERI THOMAS J ET AL)  4 August 1992 (1992-08-04)  column 2, line 14-39  column 2, line 56 -column 4, line 25;  figures 1,2</p> <p>-----</p>	<p>1,13,15,  16,19</p>

# INTERNATIONAL SEARCH REPORT

information on patent family members

Intr. International Application No

PCT/US 99/12013

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
WO 9905956	A	11-02-1999	AU	8601998 A	22-02-1999
WO 9307090	A	15-04-1993	US	5348661 A	20-09-1994
			AU	2887692 A	03-05-1993
			EP	0618883 A	12-10-1994
			CA	2120758 A	15-04-1993
WO 9737757	A	16-10-1997	US	5834385 A	10-11-1998
			AU	2591697 A	29-10-1997
US 5135521	A	04-08-1992	AU	602905 B	01-11-1990
			AU	7556587 A	21-01-1988
			CA	1305293 A	21-07-1992
			EP	0257280 A	02-03-1988
			HK	36292 A	29-05-1992
			IE	61759 B	30-11-1994
			JP	2718680 B	25-02-1998
			JP	63073958 A	04-04-1988
			MX	169475 B	07-07-1993
			NZ	220970 A	23-12-1991
			PH	23842 A	23-11-1989
			PT	85320 A,B	29-07-1988
			US	5264268 A	23-11-1993