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(12) # EUROPEAN PATENT SPECIFICATION

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(54) **Subterranean tank leak containment and detection system.**

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Description

The present invention relates to a secondary containment system for an underground storage tank. Such a system is known from the EP-A-57 973.

The present invention thus relates to the field of leak containment and detection, and is concerned with improvements in containment and detection of leaks from underground storage tanks, for example, tanks used for storage of gasoline or other petrochemicals.

Many hundreds of thousands of fuel storage tanks are located underground, particularly in service stations, and leakage from these tanks is a continuing concern. Undetected leakage from such tanks is wasteful in the loss of a non-renewable energy source, and creates hazards to public safety by contaminating subsurface earth formations or ground water sources, or by leaking into storm sewers, to create a fire and explosion hazard.

Frequently where new subterranean tanks are installed to replace failed tanks, the ground has already been contaminated by previous leakage or spillage of fluids, so that the installation of leak sensing devices adjacent the new tank or pipe will result in a false indication of leakage. There is a requirement for a leak containment and detection system which is insensitive to contamination of the environment resulting from leakage not associated with the container to be protected, is similarly immune to spillage of products during refilling or when products are drawn from the container during use, will contain any product leaked from the protected tank, and gives a prompt alarm when such a leak occurs.

All of the above criteria are met by a method and system in which leakage of petroleum products from a subterranean tank is contained in an enclosure having a leakage sensor positioned within the enclosure. The enclosure may then by sealed to prevent spillage of petroleum products or soil contamination from causing erroneous leak indications to be generated. The enclosure effectively contains leakage from the tank until repair or replacement can be effected.

In a preferred form, a method of containing and detecting leakage from a subterranean tank containing a petroleum product such as gasoline or heating oil, comprises the steps of providing adjacent the tank an electrical leak detecting cable of the type that has an insulator that is subject to degradation by the petroleum product, enclosing the cable and tank together in an enclosure impervious to the product, sealing the enclosure to prevent the ingress of the product due to accidental spillage or from other sources of the product, and connecting the cable to an electrical sensor whereby leakage from the tank into the sealed enclosure is detected by the cable and electrical sensor.

Leakage may occur from underground storage tanks from a number of causes. Since most tanks are steel, internal and external corrosion resulting in perforation of the tank is probably the primary causes of leakage. Internal corrosion results from the presence of water or acids in the stored products. External corrosion is due to groundwater and other soil-borne corrosives. Leaks may also be caused by cracks or by punctures due to sharp stones, pressing on the tank wall. In extremely dry, porous soils punctures might occur in such a way as to prevent leakage from the tank reaching the leak detector. In order to prevent this, and to ensure that any leak from the tank reaches the leak sensor in a minimum time, the present invention provides two additional important features. Firstly, a drainage mesh is warpped around the tank, inside the enclosures, and secondly, an absorbent geotextile is placed along the bottom of the tank. This latter material collects and holds leaking products so that it cannot escape to the environment without being detected. An acceptable form of drainage mesh is sold by Tensar Corporation, Marrow Georgia, as TENSAR drainage net. A suitable geotextile absorber is sold by American Engineering Fabrics Inc. 1 Coffin Avenue, New Bedford, Massachusetts, 02746 U.S.A.

In accordance with a preferred form the leak sensor is positioned in a perforated duct inside the enclosure adjacent the tank so that leakage from the tank will penetrate the duct, and be detected by the leak sensor. The perforated duct thus can be used to gain access to the leak detection cable.

Conveniently, both ends of the cable may extend outside the enclosure (in suitable protective sleeves), one end being connected to a suitable monitor, for example the Total Containment Inc. model M105B, the other end being terminated by a fixed resistance. With this configuration, the cable may be replaced after destruction by leakage by using the destroyed cable to pull a new cable through the duct, after the source of leakage has been pinpointed and the leaking container repaired and resealed. For example, in large tanks, repairs are frequently made from inside the tank, and the enclosure may be cleansed using a flushing technique with detergents, to rehabilitate the interior of the enclosure, thus avoiding the necessity of excavation.

With the secondary containment system according to the EP-A-57 973 a nylon reinforced vinyl material is used. Tests with containment systems constructed from this material on bare steel tanks however resulted in that the system leaked. Nylon reinforced vinyl material is thus not totally uneffected by petroleum products and it is impossible to

seam the material by sewing or by use of adhesivs or by electronic welding.

In view of this the secondary containment system according to the present invention is characterized in that the enclosure consists of a body sheet being formed of a linear high density polyethylene and being completely wrapped arount and welded to itself on said tank to form a sleeve thereabout and of end caps being formed of linear high density polyethylene in a shape to cover the ends of the tank and extend over be welded to said body sheet wherein at least one end cap being provided with an opening to admit said leak sensor, a drainage mesh being located between said body sheet and said tank to provide drainage channels for leakage from said tank to flow to the bottom of said body sheet and a geotextile being placed along the bottom of said tank between said tank and said body sheet to absorb and hold petroleum leaked from said storage tank for detecting by said leak sensor.

Preferred embodiments of the system according to the present invention are subject matter of the patent claims 2 and 3.

In the drawings which illustrate an embodiment of the present invention and its use,

Figure 1 is a view partly in section of an enclosure and leak detection system,

Figure 2 is a detailed view on the line A-A of Fig. 1,

Figure 3 is a perspective view illustrating the assembly of an alternate form of leak detection enclosure,

Figure 4 is a detailed view of the pump piping of Fig. 1,

Figure 5 illustrrates the application of cathodic protection to a tank,

Figure 6 is a perspective view illustrating the application of a preferred form of secondary containment to a fuel storage tank accordsing to the present invention,

Figure 7 is a cross-section through a fuel tank with the secondary containment system in place.

Figure 1 illustrates an enclosure for use with a bare steel tank, particularly useful for example in the service station environment. As illustrated the tank 30 is enclosed in a linear HDPE enclosure consisting of a pair of molded end caps 31 and a body sheet 32. The end of the cylindrical tank 33 is spaced from the inner end of the end cap 31, to provide a space for the applicant's preferred one inch perforated duct containing the leak detection cable 34. It will be noticed the leak detection cable and duct 34 extend to the bottom edge of the tank to provide the earliest possible sensing of any leakage which may occur from within the tank. The duct 34 is connected to a test point at the surface 35 by an impervious HDPE chimney fitting 36 welded to the end cap 31. The fill pipe 37 and vent pipe 38 are both encased in HDPE chimney fittings similarly welded to the body sheet 32. The piping to pumps 39 may be similarly protected with an appropriate chimney fitting of HDPE, and in addition in accordance with a further feature of the invention may be provided with leak detection cable for sensing leaks in the piping to the pumps which leak detection cable may be connected via a further impervious HDPE pipe 40 to the test point 35. The detail of the interconnection of the piping to pumps 39 and the pipe 40 is illustrated in Figure 4.

Figure 2 illustrates a detail of the junction between the end cap 31 and the body sheet 32 at the point A-A of Figure 1. As illustrated, the end cap 31 overlaps the body sheet 32 and is welded thereto with an HDPE weld at 41. The perforated duct 34 containing the sensor cable 42 passes along the bottom edge of the end cap 31 such that any leakage from the tank 30 will contact the sensor cable 42 at the earliest opportunity, to give indication of such a leak.

Figure 3 illustrates the assembly of the enclosure to a typcial gasoline storage tank. Such tank 30 is equipped with lifting lugs 43 for lifting and positioning the tank. In a conventional installation the body sheet 32 is positioned in the excavation in which the tank 30 is to be installed, the tank is placed on the body sheet 32, and the ends of the sheet are then wrapped around the tank, appropriate slits 44 being provided to accommodate the lifting lugs 43. The body sheet 32 is then welded to itself with the tank inside the sheet. Subsequently the end caps 31 containing the perforated duct 34 and leak detection cable 42 are mounted on the ends of the tank, and the end caps 31 are welded to the body sheet using known high density polyethylene welding techniques. Patches are welded over the lifting lugs. With the tank entirely sealed in the high density polyethylene container all leakage from the tank is completely prevented.

A preferable material for use as the body sheet and end caps is linear high density polyethylene the thickness of the sheet material is at least 0.100 inch.

The enclosure components may be prefabricated to the tank dimensions and shipped to the tank manufacturer where the components are permanently attached to the tank to protect the tank during transportation. On site the tank may be pressure tested according to local requirements. If the enclosure is to be applied on site, the body sheet and end caps can be shipped as a kit and welded to the tank. The leak detection cable is fitted into the end fittings, and the entire enclosure is welded together on the tank prior to burial. The

piping to the pumps, filler pipes and vent pipes can also be fitted with separate leak detection systems. Special chimney fittings are designed to fit over the tank piping and are clamped to the pipes with the bases welded to the enclosure so as to prevent liquids from entering the enclosure at these locations. All wiring connections are done after backfilling so as to allow the tanks and piping systems to be monitored by a single monitor.

Figure 4 illustrates a detail of Figure 1 in which a tank 30 sealed within a body sheet 32 is provided with a chimney fitting 45 also welded to the body sheet 32 through which piping to the fuel dispensing pumps is passed. As illustrated in Figure 4 the chimney fitting 45 is clamped to the pipe 46 by a clamp 47, and a further HDPE sleeve 48 is fitted over the piping 46 and the chimney 45, and is clamped by a screw clamp 49 about the piping 46. Within the sleeve 48, a further leak detection cable 50 contained within a non-perforated duct 40 is looped around the piping 46 just above the clamp 49, to provide a mechanism for detecting leaks in the piping 46 which might otherwise go undetected, or which, if clamps 47 and 49 were not provided on the piping 46, leak back into the enclosure to give an erroneous detection of a leak in the tank per se.

Figure 5 illustrates the application of cathodic protection to a tank positioned in an enclosure. The tank 30 is provided with a standard cathodic protection cable 62 welded at 61 to the tank 30. The other end of cable 62 is attached to a bag of chemicals 64. The cable 62 is fed through the HDPE pipe 36 together with the leak detection cable 34. The chemical bag 64 is buried in the ground and acts as a sacrificial anode in the usual way.

It will be appreciated that this system specifically lends itself to replacement of the sensor cable without any excavation, and the system can be filled with water, causing the petroleum-product to float out through the test point. The water may be pumped out from the system, and a new cable installed and the system reactivated. This technique is particularly attractive in the case of large tanks, which are frequently repaired from the inside for example by re-welding previously cracked welds, or welding plates over leak locations.

Figures 6 and 7 illustrate a preferred form of secondary containment system of the present invention. A cylindrical tank 30, preferably without lifting lugs, is wrapped in a body sheet 32 of HDPE the sheet 32 is rectangular when flat and is of sufficient width and length to completely cover the tank except for the ends. As before the sheet 32 is wrapped around the tank and welded in place. Between the tank 30 and the body sheet 32 are a geotextile absorber 120 and a drainage mesh 121. The mesh 121 provides channels for the flow of leakage from the tank 30 to the absorber 120 which ensures that any leakage is retained in the vicinity of the leak sensor located in one of the end caps 122. The end caps 122 and 123 are welded to the body sheet to complete the secondary containment system. In place of the drainage mesh, the interior surface of the body sheet could be suitably ribbed to provide the required flow channels. Thus, even if punctured by a sharp object, leakage will flow to the leak sensor. The tank should be installed with the end containing the leak sensor lower than the other end, to assist in early detection of leakage. One of the end caps 122 is provided with a perforated tube or well in which the leak sensor may be located.

While electronic monitoring of leakage is obviously superior to other methods, the presence of leakage in the perforated tube or well may be detected if required by a dipstick or other device. Such manual systems are undesirable as they require an operator to perform the test at the tank site. Electronic sensing is adapted for remote installation location, and without the presence of supervisory personnel on site.

Claims

1. A secondary containment system for an underground storage tank (30) comprising a leak sensor and an enclosure sealed around said tank (30) and said leak sensor characterized in that said enclosure consists of a body sheet (32) being formed of linear high density polyethylene and being completely wrapped around and welded to itself on said tank (30) to form a sleeve thereabout and of end caps (31,122,123) being formed of linear high density polyethylene in a shape to cover the ends of said tank (30) and extend over and be welded to said body sheet (32) wherein at least one end cap (122) being provided with an opening to admit said leak sensor, a drainage mesh (121) being located between said body sheet (32) and said tank (30) to provide drainage channels for leakage from said tank (30) to flow to the bottom of said body sheet (32) and a geotextile (120) being placed along the bottom of said tank (30) between said tank (30) and said body sheet (32) to absorb and hold petroleum leaked from said storage tank (30) for detection by said leak sensor.

2. A system according to claim 1,wherein said storage tank is cylindrical and said body sheet has a rectangular shape when flat.

3. A system according to claim 1 or 2,wherein

said body sheet being formed of linear high density polyethylene in a thickness of about 0,10 Inches.

Revendications

1. Dispositif formant réservoir secondaire pour une cuve de stockage enterrée (30) comprenant un détecteur de fuites et une enveloppe fermée, de manière étanche, autour de ladite cuve (30) et dudit détecteur de fuite, caractérisé en ce que ladite enveloppe se compose d'une feuille formant corps (32) formée de polyéthylène haute densité et enveloppant totalement ladite cuve (30) et étant soudée à elle-même pour former un manchon autour de cette dernière, et de couvercles d'extrémité (31, 122, 123) formés de polyethylène linéaire haute densité, présentant une forme permettant de recouvrir les extrémités de ladite cuve (30) et de déborder de ces dernières pour être soudés à ladite feuille formant corps (32), selon lequel au moins un couvercle d'extrémité (122) est pourvu d'une ouverture prévu pour l'introduction dudit détecteur de fuites, un treillis d'assèchement (121) étant placé entre ladite feuille formant corps (32) et ledit réservoir (30) pour fournir des canaux d'assèchement pour permettre aux fuites provenant de ladite cuve (30) de s'écouler vers le fond de ladite feuille formant corps (32) et un géotextile (120) étant placé contre le fond deladite cuve (30) entre ladite cuve (30) et ladite feuille formant corps (32) pour absorber et retenir le pétrole s'échappant de ladite cuve de stokage (30) et assurer sa détection par ledit détecteur de fuites.

2. Dispositif selon la revendication 1, caractérisé en ce que ladite cuve de stockage est cylindrique et ladite feuille formant corps présente une forme rectangulaire lorsqu'elle est posée à plat.

3. Dispositif selon la revendication 1 ou 2, caractérisé en ce que ladite feuille formant corps est formée de polyéthylène linéaire haute densité d'une épaisseur d'environ 0,10 pouce. (0,254 cm)

Patentansprüche

1. Ein Zweiteinschlußsystem für einen unterirdischen Speicherbehälter (30), der einen ein Leck erfassenden Meßfühler und eine den Behälter (30) und den das Leck erfassenden Meßfühler dicht einschließende Hülle umfaßt, **dadurch gekennzeichnet,**

daß die Hülle umfaßt:
eine Rumpffolie (32), welche aus linearem, hochdichtem Polyäthylen besteht, und völlig um den Behälter (30) herumgewickelt und mit sich selbst verschweißt ist, um um diesen eine Hülse zu formen,
Endkappen (31,122,123), welche aus linearem, hochdichtem Polyäthylen so geformt sind, daß sie die Enden des Behälters (30) bedecken und sich über die Rumpffolie (32) erstrecken und mit ihr verschweißt sind, wobei mindestens eine der Endkappen (122) mit einer Öffnung zum Durchlaß des ein Leck erfassenden Meßfühlers versehen ist,
ein Ablaufnetz (121), welches zwischen der Rumpffolie (32) und dem Behälter (30) angeordnet ist, um Ablaufkanäle für die aus dem Behälter (30) kommende Leckflüssigkeit vorzusehen, so daß die Leckflüssigkeit zur tiefsten Stelle der Rumpffolie fließt,
und ein Geotextil (120), welches entlang der tiefsten Stelle des Behälters (30) zwischen dem Behälter (30) und der Rumpffolie (32) angeordnet ist, um aus dem Speicherbehälter (30) ausgelaufenes Erdöl zur Erfassung durch den ein Leck erfassenden Meßfühler aufzunehmen und zu halten. umfaßt.

2. Ein System nach Anspruch 1, bei welchem der Speicherbehälter zylindrisch ist, und die Rumpffolie eine rechteckige Form aufweist, wenn sie flach liegt.

3. Ein System nach den Ansprüchen 1 oder 2, bei welchem die Rumpffolie aus linearem, hochdichtem Polyäthylen mit einer Stärke von ungefähr 2,53 mm (0,10 Inches) gebildet ist.

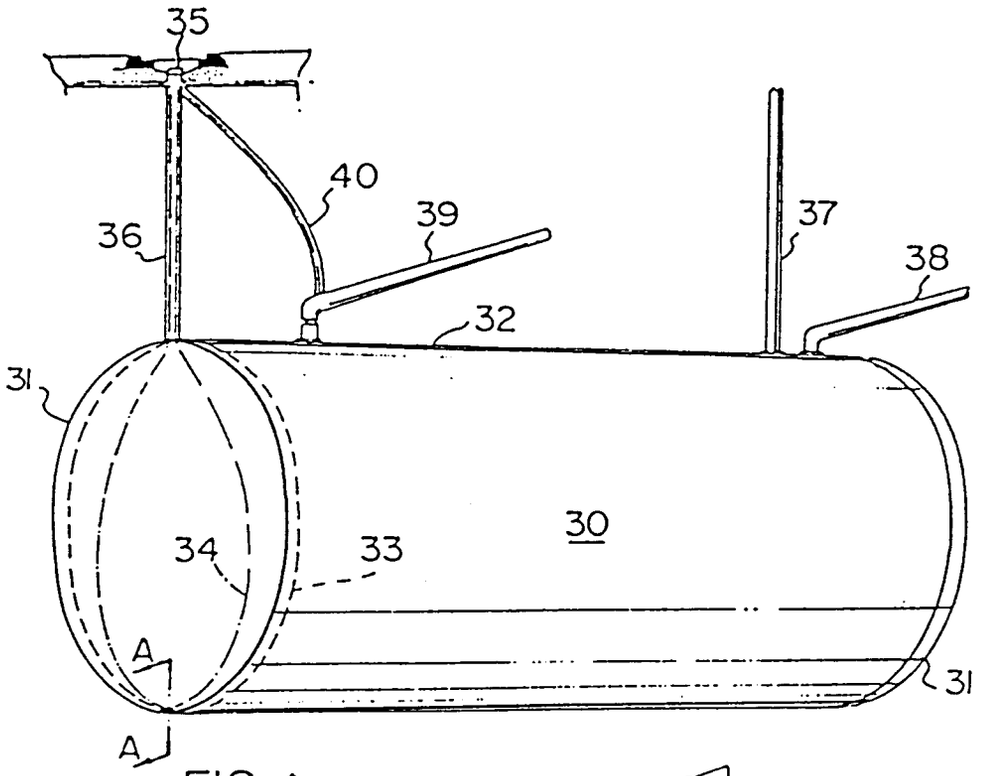

FIG. 1

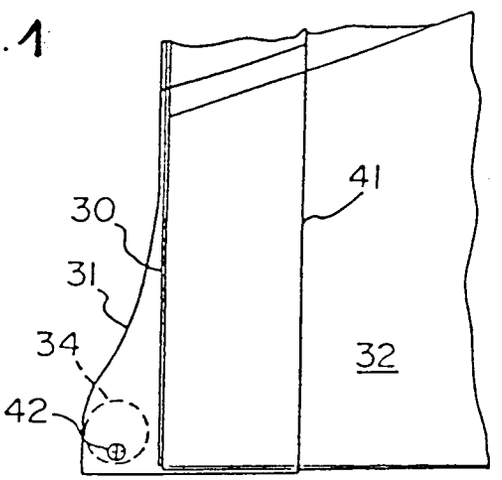

FIG. 2

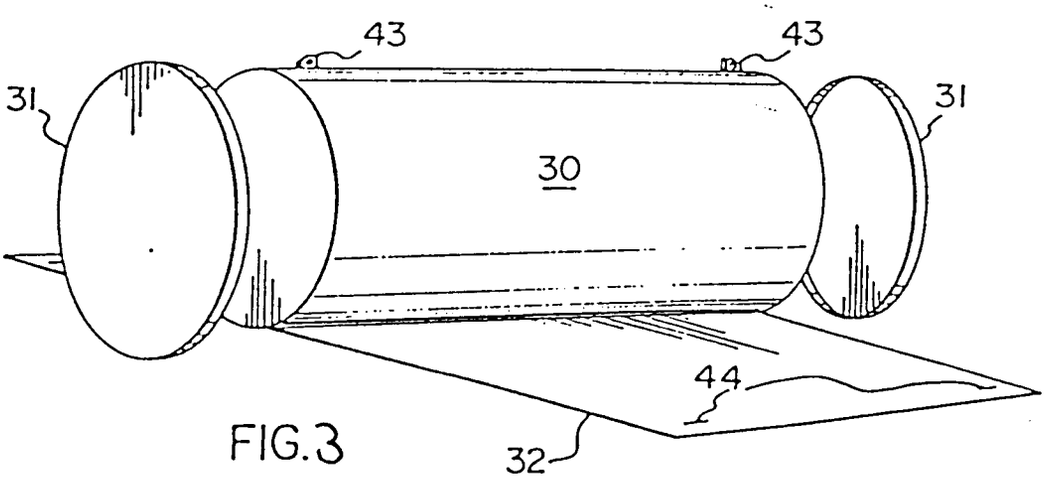

FIG. 3

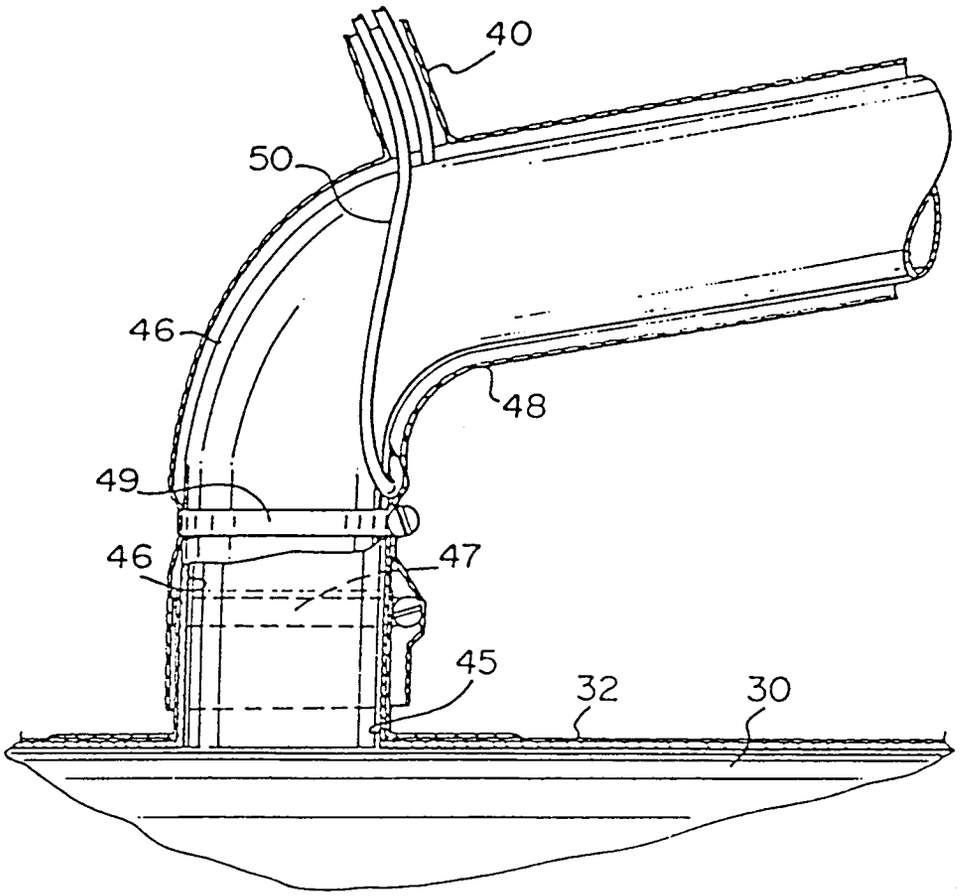

FIG. 4

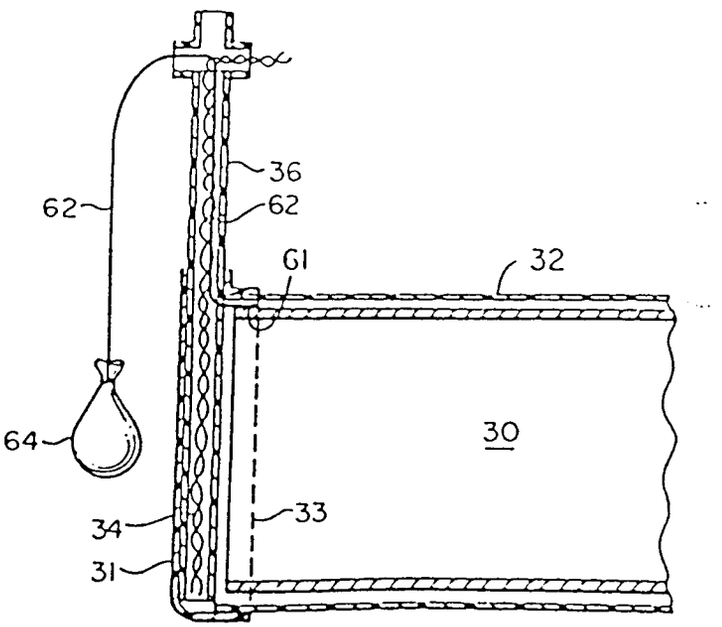

FIG. 5

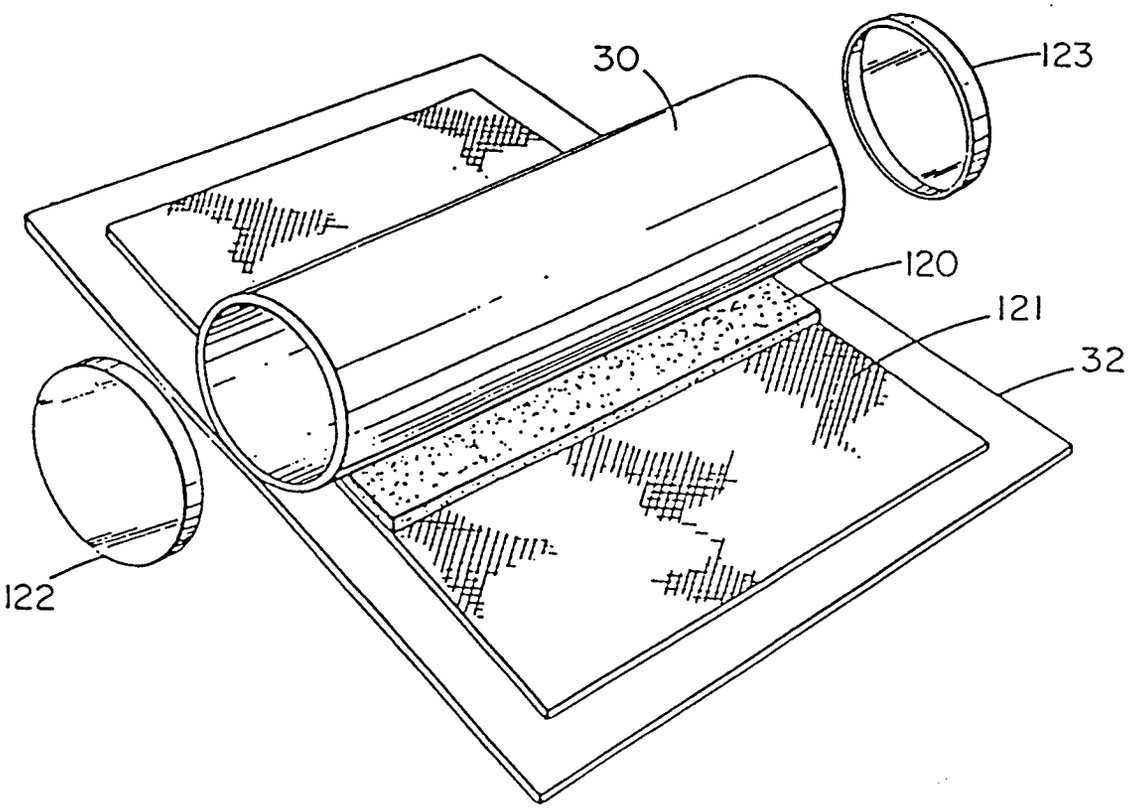

FIG. 6

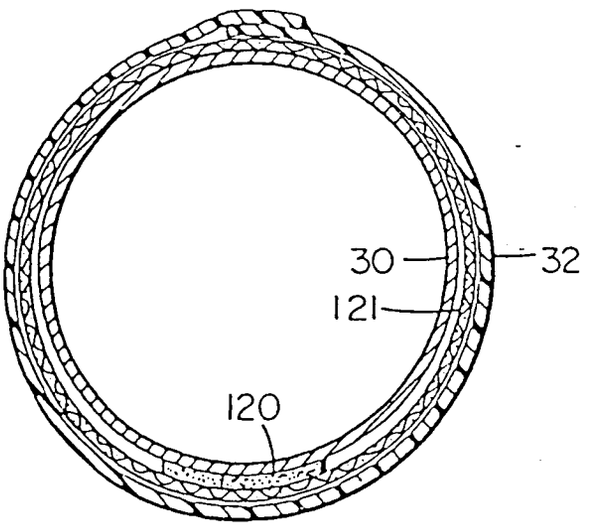

FIG. 7