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SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



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SOLICITUD DE:

☒ Patente de Invención.

☐ Patente de Modelo de Utilidad.

☒ Capítulo I.

☐ Capítulo II.

2

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C.E. ☐ Otro ☐

Cual _____

Número _____

3

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Número 80.410.337 TP 57492

4

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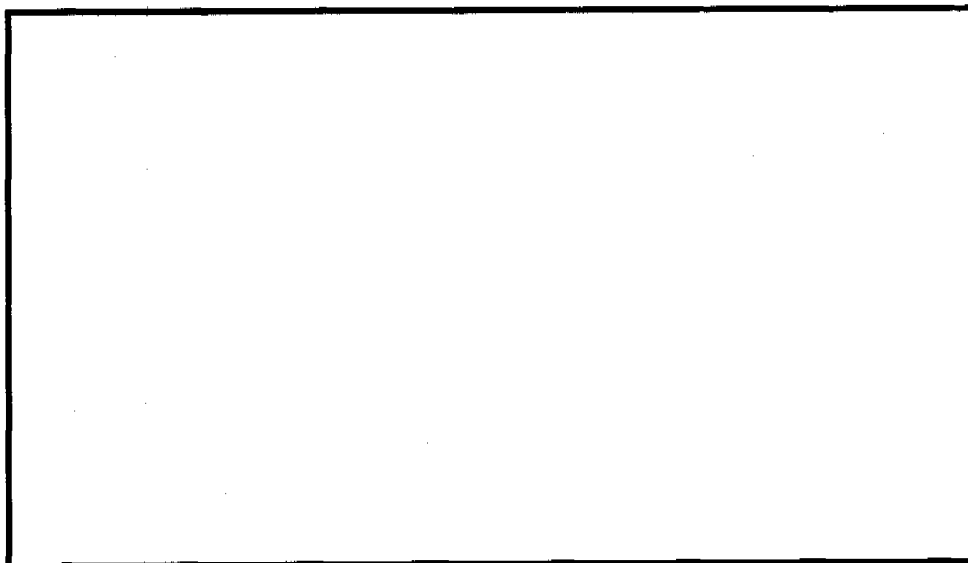
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Instrucciones para el diligenciamiento del presente formulario, ver reverso de esta página.

2020-F06 (01-11-15)

- ☒ Comprobante de pago de la tasa de presentación de la solicitud. \$482.000
- ☒ Documento que acredita la existencia y representación legal cuando el solicitante sea persona jurídica.
- ☒ Poderes, si fuere el caso. **Fotocopia Autenticada**
- ☒ Documento de cesión del inventor al solicitante o a su causante.
- ☐ Declaraciones
- ☒ Copia de la solicitud internacional. (Resumen, descripción, reivindicaciones, dibujos)
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- ☒ Otros: Extracto para Publicación y Tarjeta de Archivo Temático
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1

11 FIGURA CARACTERÍSTICA:**12** Solicito la concesión de la patente,NOMBRE: JUAN PABLO CADENA SARMIENTO

FIRMA:

C.C. 80.410.337 de Usaquén TP 57492 del C.S.J.

Instrucciones para la presentación de los anexos, ver reverso de esta página.

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***** CONCEPTO *****

CANT.	RENTISTICO	CONCEPTO	TOTAL CONCEPTO
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TOTAL :			\$ 482,000.00

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RESPONSABLE : _____

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From the INTERNATIONAL BUREAU

PCTNOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

To:

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ROYAUME-UNI

Date of mailing (day/month/year) 07 June 2007 (07.06.2007)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference SMRT,01+2PCT	
International application No. PCT/GB2005/050204	International filing date (day/month/year) 21 November 2005 (21.11.2005)

1. The following indications appeared on record concerning:		
☒ the applicant	☐ the inventor	☐ the agent
☐ the common representative		
Name and Address LUCAS, Brian, Ronald 135 Westhall Road Warlingham Surrey CR6 9HJ United Kingdom	State of Nationality GB	State of Residence GB
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	Facsimile No.	
	Teleprinter No.	
2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:		
☐ the person	☐ the name	☐ the address
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3. Further observations, if necessary: The applicant identified in Box 1 should be deleted from the records		
4. A copy of this notification has been sent to:		
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☐ the International Searching Authority	☐ the elected Offices concerned	
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The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Olaiz Alicia
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Form PCT/IB/306 (October 2005)	Telephone No. +41 22 338 74 01

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24th May 2007

The International Bureau of WIPO
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1211 Geneva 20
Switzerland

Dear Sirs

Re: PCT Patent Application No. PCT/GB2005/050204
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(Filed 21st November 2005)
claiming priority from
USSN 60/635,467 (Filed 13th December 2004)
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Applicant: Smart Pipe Company, LP
Inventors: CATHA, S.C.; CHARBONEAU, K.R.; GALLAGHER, J.L.;
MANDICH, I.C.; and STRINGFELLOW, W.D.:
"Systems and Methods for Making Pipe Liners"
Case: SMRT,001+2-PCT

BY FACSIMILE

This is simply to advise you that I have assigned, and do hereby assign all my right, title and interest if any in the above identified PCT application to my co-applicant and that this case should now proceed in their name alone.

I am however to remain as authorised representative.

Would you please return the attached copy of this letter to acknowledge safe receipt hereof.

Yours faithfully

Brian Lucas/gar
Chartered Patent Agent
European Patent Attorney

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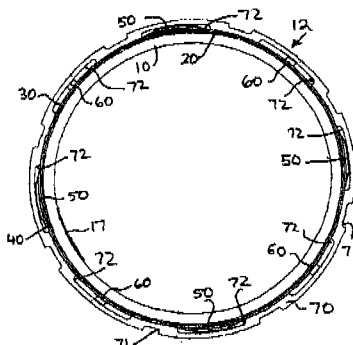
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(54) Title: SYSTEMS AND METHODS FOR MAKING PIPE LINERS



(57) Abstract: A liner (12) for pipe, the liner comprising a first layer (10) comprising a hollow cylinder of polymeric material, a second layer (20) comprising wrap material, the wrap material wrapped around the first layer, a third layer (30) comprising wrap material wrapped around the second layer, the liner (12) having a first end spaced apart from a second end, at least one strengthener member (40) on the liner and extending from the first end to the second end of the liner, the liner (12) comprising a stand-alone structure.

WO 2006/064284 A1

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WO 2006/064284 A1



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

- 1 -

SYSTEMS AND METHODS FOR MAKING PIPE LINERS

FIELD OF THE FIRST AND THIRD INVENTIONS

5 The present invention in certain aspects, is directed to systems and methods for making pipe liners, to lined pipe and pipelines, to pipelines with liners and fiber optic sensors, to methods for lining pipe and pipeliners, and, in certain particular aspects, to
10 continuous reinforced thermoplastic pipe liner intended for use as a stand alone pipe liner in the restoration of degraded pipelines.

BACKGROUND OF THE FIRST AND THIRD INVENTIONS

15 Pipeline and/or underground transport of liquids and gases has been utilized for many years. Such pipeline and/or underground transport has proven to be an efficient and safe manner in which to transport
20 potentially explosive, flammable, and/or toxic liquids (e.g. crude oil) and gases (e.g. methane and propane) over long distances. One method for providing such long distance underground transport has been through metal tubes and pipes. In the past, the utilization of metals
25 (such as steel, copper, lead, and the like) was effective from cost and raw material supply perspectives. However, with the population growing throughout the world and the necessity for transporting liquids and gases to more locations increases, the continued utilization of such
30 metal articles has become more and more difficult for a number of reasons. Initially, the production of such metal tubes and pipes is done with high temperature production methods at specific foundries which are often located a substantial distance from the desired
35 installation site. Such off site production can require

- 2 -

transport of cumbersome metal articles to an installation location and then subsequent placement into already dug channels. These procedures can be difficult to follow since metal articles are rather heavy and must be connected together to form the desired pipeline. Additionally, in order to reduce the number of connections between individual pipes, longer metal pipes could be formed, which adds to the complexity with an increase in required welded connections. Further problems associated with metal pipes and tubes include the potential for internal and external corrosion (which may contaminate the transported liquid or gas), the low threshold of earth shifting resistance which could cause a break within the pipeline, and the difficulty in replacing worn out metal pipes in sections, again due to the metal pipe weight, metal pipe length, and connection welds. These problems have proven to be extremely troublesome in certain geographic areas which are susceptible to earthquakes and tremors on a regular basis. When unexpected earthquakes have occurred in the past, the metal gas and liquid pipelines have not proven to be flexible enough to withstand the shear forces applied thereto and explosions, leaks, or discontinued supplies to such areas have resulted. These metal articles have remained in use because of their ability to withstand high pressures. Furthermore, although such metal pipes are designed to withstand such high pressures (e.g. above 80 bars) once a crack develops within the actual metal pipe structure, it has been found that such cracks easily propagate and spread in size and possibly number upon the application of continued high pressure to the same weakened area. In such an instance, failure of the pipe is therefore imminent unless closure is effectuated and repairs or replacements are undertaken.

Although there is a need to produce new pipelines in

- 3 -

various locations around the world, there is also a growing need to replace the now deteriorating pipelines already in use. Aging pipelines have recently caused concern as to the safety of utilizing such old articles.

5 Unexpected explosions have occurred with tragic consequences. Thorough review and replacement of some old metal pipes is thus necessary. Some of these older pipelines were constructed in what were rural areas but are now heavily populated urban areas, thus increasing
10 the risk associated with a failure. There is a desire to completely replace old pipelines following the same exact routes. In heavily populated areas, the dig and replace method becomes extremely difficult, inconvenient and costly.

15 Due to the difficulties noted above, there is a need to develop pipeline materials that are safer, longer lasting, easier to install, non corroding, non crack propagating, and more flexible. To date, there have been some thermosetting or thermoplastic articles which are
20 designed for such applications. These include certain fiber wound reinforcement materials (including fiberglass, poly aramids, polyesters, polyamides, carbon fibers, and the like). However, the resultant articles do not include specific fabric reinforcements (they are
25 fibers wound around specific layers of plastic material) and thus are difficult and rather costly to produce. Furthermore, such fiber wound materials often cannot be easily produced at the pipe installation site due to the complexity of creating fiber wound reinforcement articles
30 subsequent to thermoplastic or thermosetting layer production. Additionally, with off site production, transport and in ground placement can be a difficult problem. Thus, although some improvements have been provided in the past in relation and in comparison to
35 metal pipes and tubes, there simply is no viable

- 4 -

alternative presented to date within the pertinent prior art known to the present inventor which accords the underground liquid and gas transport industry a manner of replacing or restoring such high pressure metal articles.

5 Pipe liners have been used in a variety of applications to stop further degradation of a pipeline due to internal corrosion, to provide improved resistance to abrasion, and to stop leakage at joints. Pipe liners are generally designed to resist only installation
10 loadings and to serve as a pressure barrier for transported fluids. Operating loadings are transferred directly to the wall of, and resisted by, a host pipe that may have already exceeded its design life. Pipe liners typically do not restore the operating parameters
15 of a pipeline. Pipe liners come in a variety of known forms. These include cured in place pipes ("CIPP"). The CIPP product is a fiber reinforcement that is impregnated with an un cured thermosetting resin that is used primarily in sewer and watermain rehabilitation. The CIPP
20 is inserted into the host pipeline and expanded into contact with the host pipe walls and then cured, often by pumping heated water through the CIPP which is reinforced by the pipeline. CIPP liners are designed to resist only the installation forces and typically do not contribute,
25 or add significantly to, to the strength of the host pipeline. Further they generally do not provide protection against external corrosion. Examples of this type of pipe liner are disclosed in U.S. Patents 4,064,211 and 6,708,729 (and in prior art cited therein).
30 The use of such pipe liners is well documented in the industry literature and is not applicable to the high pressure applications.

Another type of prior art pipe liner is the extruded thermoplastic pipe liner. These products are continuous
35 lengths of thermoplastic material such as HDPE (high

- 5 -

density polyethylene), nylon, PVC (polyvinylchloride) alloys, and other such materials commonly used for piping applications and/or corrosion mitigation. These materials are sometimes used in combination, that is, multiple
5 layers of different materials, or with discrete length fiber reinforcement, to obtain improved properties. Limitations of this type of product are that it relies on the strength of a host pipeline to resist operating stresses; it has limited tensile strength and can
10 therefore be pulled into a host pipeline only in relatively short lengths, usually one mile or less; and it cannot provide protection against external corrosion. A further limitation of this type of product is the ability of fluids to permeate through the wall. All
15 thermoplastics are permeable to some degree. Gases that permeate tend to be collected in a space at the pipe liner host-pipe interface where pressure can increase to a level approaching the operating pressure of the pipeline. When the pipeline pressure is suddenly reduced,
20 the entrapped gas follows the normal gas laws and expands. Such expansion, often results in a buckling of the pipe liner called "liner collapse". As a result, pipelines with polymer pipe liners are normally equipped with "venting systems" and operational procedures are
25 established to "vent" permeated fluids (see, e.g. U.S. Patent 5,072,622 which describes a method for removal of such gases before they are able to collapse a pipe liner). Methods developed to install thermoplastic pipe liners include swage lining, the use of sized rollers and
30 liner tension to reduce the pipe liner diameter (see, e.g. U.S. Patent 6,240,612), and the "fold and form" method in which the round liner is folded into a "C," "H," "W," "U" or other shape for insertion (see, e.g. U.S. Patents 4,863,365; 4,985,196; 4,998,871 and
35 6,058,978). Applications involving the use of such pipe

- 6 -

liners are well documented in the industry literature.

Another well-known pipe liner product and method for rehabilitation of pipelines is the flexible yet rigid spoolable composite pipe member which can be pulled or otherwise inserted into a host pipe. The spoolable composite pipe is of significantly smaller diameter than the host pipe to allow it to be installed. This pipe and method of installation can provide increased pipeline pressure rating and increased internal and external corrosion resistance, but can result in a significant reduction in the effective inside diameter of the host pipe. This results in an increase in pipeline operating costs. An additional significant limitation of this product is the difficulty of road transport of rigid spoolable pipe sizes greater than about four inches in diameter in sufficient continuous length to be cost effective (see, e.g. U.S. Patents 3,769,127; 4,053,343, 5,755,266; 5,828,003 and 6,065,540).

Another well-known documented pipe liner product and method for the rehabilitation of pipelines is reinforced thermoplastic pipe which can be inserted or otherwise pulled into a host pipe. This product typically consists of an extruded thermoplastic liner that is reinforced by fiber or tapes which are protected by a cover. This relatively flexible, yet rigid, pipe and method can provide increased pipeline pressure rating and increased internal and external corrosion resistance, but can result in a significant reduction in the effective inside diameter of the host pipe, and in increased pipeline operating costs. Another limitation of this method is the difficulty of road transport of rigid pipe sizes greater than about four inches in diameter in sufficient continuous length to be cost effective (see, e.g. U.S. Patents 2,502,638; 4,000,759; 4,384,595; 5,072,622; and 6,305,423).

- 7 -

Wound-fiber reinforced plastic pipe is commonly available in a variety of forms, including discrete length products in which a specific length of pie, e.g. 30-feet, is produced and continuous length products, often referred to as "Spoolable Composite Pipe" or "SCP." One common type of SCP utilizes a polymer liner or core pipe reinforced by layers of wound-fibers in a polymer matrix, e.g. epoxy or polyester, see, e.g. U.S. Patents 6,782,932, 5,933,945, 5,921,285, 4,384,595, 4,142,352 and 4,120,324. Another common type of SCP has a polymer liner or core pipe reinforced by wound-tapes or fibers using an orbital process in which material is pulled from bobbins or rolls that orbit a polymer liner as it translates through the apparatus; see, e.g. U.S. Patents 2,502,638, 3,616,072 4,259,139 and 4,495,018 and U.S. Patent Application Pub. No. 20040144440, U.S. Ser. No. 351,350 filed Jan. 27, 2003.

SUMMARY OF THE FIRST AND THIRD INVENTIONS

20

The present invention, in at least certain embodiments, discloses pipe liners, methods to make them, methods to install them, and lined pipe or pipelines with a multi-component liner and, in one aspect, a fiber optic sensor system and/or a communications system, e.g. a fiber optic communications system.

Certain pipe liners produced in accordance with certain embodiments of the present invention are a stand alone structure which is capable of withstanding operating and installation loadings and, optionally, with embedded measurement and redundant sensing devices for monitoring the integrity of a restored pipeline on a continuous basis. The present invention also discloses lined pipe and pipelines with the capability for communications/control through a communication system,

- 8 -

15 e.g. a fiber optic communication system with fiber optic
cables and/or apparatus, in one aspect with collection
and removal apparatus of any permeated fluids. In certain
particular aspects, the present invention discloses
5 pipelines (e.g. relatively large diameter degraded
pipelines) which are restored to original or near-
original specification without digging and without
replacement.

10 The present invention discloses, in at least certain
aspects, a light weight high strength yet flexible multi-
component pipe liner structure that can be installed as a
stand alone pipe liner restoring a pipe or a host
pipeline to (or near) its original performance parameters
and original service life, while providing increased
15 internal and external corrosion protection and increased
protection from damage, e.g. during earthquakes,
accidents, and acts of terrorism. In certain aspects, a
"stand alone" pipe liner as used herein is a pipe liner
that withstands all (or substantially all) installation
20 and operational loads without assistance.

The present invention discloses, in at least certain
aspects, a liner with sufficient axial strength to allow
for the lining of existing pipelines with lengths in
excess of several miles (e.g. in excess of five miles or
25 in excess of ten miles), in one aspect with single pull
installation.

The present invention discloses, in at least certain
aspects, apparatus and structure within a pipe or
pipeline for collecting and handling permeated fluids,
30 especially gases, that might otherwise cause the pressure
barrier to collapse when pipeline pressure is reduced
(and, in some cases, suddenly reduced).

The present invention discloses, in at least certain
aspects, a method for continuous measuring and monitoring
35 of the integrity of a pipeline.