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FORM 1

SPRUSON & FERGUSON

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

Amsted Industries Incorporated, incorporated in Delaware, of 44th Floor - Boulevard Towers South, 205 North Michigan Avenue, Chicago, Illinois, 60601, UNITED STATES OF AMERICA, hereby apply for the grant of a standard patent for an invention entitled:

Method of Applying a Polyolefin Coating to Pipe and the Product Made Thereby

which is described in the accompanying complete specification.

Details of basic application(s):-

Basic Applic. No:	Country:	Application Date:
516,358	US	30 April 1990

The address for service is:-

Spruson & Ferguson
Patent Attorneys
Level 33 St Martins Tower
31 Market Street
Sydney New South Wales Australia

DATED this FOURTEENTH day of MARCH 1991

Amsted Industries Incorporated

By:

Registered Patent Attorney

TO: THE COMMISSIONER OF PATENTS
OUR REF: 157515
S&F CODE: 50490

5020573 15/03/91

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Spruson & Ferguson

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AUSTRALIA CONVENTION STANDARD & PETTY PATENT DECLARATION SFP.

COMMONWEALTH OF AUSTRALIA

THE PATENTS ACT 1952

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT

In support of the Convention Application made for a patent for an invention entitled:

Title of Invention

Method of Applying a Polyolefin Coating to Pipe and the Product Made Thereby

Full name(s) and address(es) of Declarant(s)

I/~~We~~ Gordon R. Lohman

of AMSTED Industries Incorporated
44th Floor - Boulevard Towers South
205 North Michigan Avenue
Chicago, Illinois 60601 USA

do solemnly and sincerely declare as follows:–

Full name(s) of Applicant(s)

~~1. I am/We are the applicant(s) for the patent~~

(or, in the case of an application by a body corporate)

1. I am/~~We are~~ authorised by

AMSTED Industries Incorporated

the applicant~~(s)~~ for the patent to make this declaration on its/~~their~~ behalf.

2. The basic application~~(s)~~ as defined by Section 141 of the Act was/~~were~~ made

Basic Country(ies) — in USA

Priority Date(s) — on April 30, 1990

Basic Applicant(s) — by Thurman H. Upchurch

Full name(s) and address(es) of inventor(s)

3. ~~I am/We are the actual inventor(s) of the invention referred to in the basic application(s)~~

(or where a person other than the inventor is the applicant)

3. Thurman H. Upchurch

of 2427 Castle Place
Lynchburg, Virginia 24503
United States of America

~~(respectively)~~

is/~~are~~ the actual inventor~~(s)~~ of the invention and the facts upon which the applicant~~(s)~~ is/~~are~~ entitled to make the application are as follows:

Set out how Applicant(s) derive title from actual inventor(s) e.g. The Applicant(s) is/are the assignee(s) of the invention from the inventor(s)

The Applicant is the assignee of the invention from the inventor by the assignment dated April 19, 1990.

4. The basic application~~(s)~~ referred to in paragraph 2 of this Declaration was/~~were~~ the first application~~(s)~~ made in a Convention country in respect of the invention ~~(s)~~ the subject of the application.

Declared at Chicago, IL this 3rd day of December 1990

[signature]

Signature of Declarant(s)
Gordon R. Lohman

SFP4 To: The Commissioner of Patents 11/81

(12) PATENT ABRIDGMENT (11) Document No. AU-B-73539/91
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 631729

(54) Title
METHOD OF APPLYING A POLYOLEFIN COATING TO PIPE AND THE PRODUCT MADE THEREBY

International Patent Classification(s)
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(56) Prior Art Documents
AU 591388 13326/88 B28B F16L
AU 516111 22307/77 F16L
US 4314957

(57) Claim

1. A method for producing a cylindrical body having an internal cementitious wall with a continuous internal coating of polymer, said method comprising:

preparing a mixture of cementitious mortar containing a first quantity of powdered polymer material;

applying said mixture to the internal surface of a cylindrical form;

rotating said form at a speed sufficient to spread said mixture evenly across said internal surface to form a cementitious wall and to stratify said mixture under centrifugal force to provide a cement rich outer wall layer and a polymer rich inner wall layer, said cementitious wall having an internal strata that is progressively richer in polymer from said outer layer to said inner layer and having radially interlocked continuums of cement and polymer;

curing said cementitious wall;

drying at least said inner layer to remove moisture from said polymer rich inner layer;

heating said inner layer to a polymer fusion temperature and applying a second quantity of polymer to said inner layer whereby a continuous polymer coating is formed on said cementitious wall.

7. An improved cylindrical body having an internal cementitious coating with a continuous internal coating of polymer, said cylindrical body comprising:

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a first cylindrical cementitious coating having a first outer gradient comprising substantially cement and a second outer gradient forming a cylindrical inner surface of mixed cement and first polymer substances imbedded therein with said first polymer substances in greater concentration near the inner surface of said second outer gradient; and

a second cylindrical continuous coating comprising substantially a second polymer material applied to said cylindrical inner surface and bonded directly to said first imbedded polymer substances of said second outer gradient.

23. An improved ferrous pipe comprising:

a cylindrical ferrous shell having an inner surface, a cementitious inner coating formed on the inner surface of said cylindrical ferrous shell, said cementitious inner coating comprising a gradient of polymer enriched cement wherein said polymer increases in concentration in a radial direction inwardly from said cylindrical ferrous shell, said cementitious inner coating forming an inner cylindrical layer; and

a second polymer material forming an inside coating on said inner cylindrical layer.

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S & F Ref: 157515

FORM 10

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE:

Class Int Class

Complete Specification Lodged:
Accepted:
Published:

Priority:

Related Art:

Name and Address of Applicant: Amsted Industries Incorporated
44th Floor - Boulevard Towers South
205 North Michigan Avenue
Chicago Illinois 60601
UNITED STATES OF AMERICA

Address for Service: Spruson & Ferguson, Patent Attorneys
Level 33 St Martins Tower, 31 Market Street
Sydney, New South Wales, 2000, Australia

Complete Specification for the invention entitled:

Method of Applying a Polyolefin Coating to Pipe and the Product Made Thereby

The following statement is a full description of this invention, including the best method of performing it known to me/us

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ABSTRACT OF THE DISCLOSURE

Iron pipe and other hollow articles are lined with a cementitious mortar containing a quantity of polymer particles and the pipe is rotated about its axis so as to stratify the mortar and develop a polymer rich inner surface that is subsequently cured, dried and heated to the polymer fusion temperature and then coated with a continuous layer of pure polymer.

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METHOD OF APPLYING A POLYOLEFIN COATING TO PIPE AND THE PRODUCT MADE THEREBY

Background of the Invention:

This invention relates to the application of a continuous impervious polymer coating to a cementitious wall and more particularly is directed to a method of applying a polyethylene coating to the interior of a hollow article especially a cylindrical body such as cement pipe and cement lined iron pipe and to the coated pipe resulting therefrom.

It is known that plastic coatings, including coatings of polyethylene and other olefin polymer or copolymer materials, provide reduced friction coefficients and protection against corrosion and or erosion when applied to metal and or cement surfaces. This applies particularly to pipes made of metal or cement which heretofore have benefited from protective internal coatings of bitumen or coaltar epoxy as shown in U.S. patent No. 4,474,134, the disclosure of which is included herein by reference, to resist the destructive properties of liquids such as potable water, sewage or other substances transported therethrough. Indeed some ferrous pipes utilize an interior layer of cement as a protective coating to resist corrosion. Apparatus for producing cement lined pipe and other vessels is shown in U.S. patents No. 4,414,918; 3,563,791 and 2,598,972, the details of which are included herein by reference.

While the advantages of a plastic interior pipe coating have been known, the application of materials such as polyolefins has required expensive surface preparation and even so the coating tends to delaminate from the pipe surface. Prior techniques for applying polyolefins such as polyethylene to the interior surface of pipe are described in U.S. patents Nos 3,348,995; 4,007,298; 4,254,165 and 4,407,893, the details of each are also incorporated herein by reference. While the following description deals largely with polyethylene, it is to be understood that other known thermo plastic coating material having desirable coating characteristics, such as polyurethane and polyvinylchloride may also be suitable provided they are chemically stable, compatible with the ingredients of cement and otherwise suitable for rotational molding techniques.

Summary of the Invention:

Accordingly, it is a principal object of the present invention to provide an improved method for surface bonding a coating of plastic material and the article produced thereby.

Accordingly, according to one form of the invention there is disclosed a method for producing a cylindrical body having an internal cementitious wall with a continuous internal coating of polymer, said method comprising:

preparing a mixture of cementitious mortar containing a first quantity of powdered polymer material;

applying said mixture to the internal surface of a cylindrical form;

rotating said form at a speed sufficient to spread said mixture evenly across said internal surface to form a cementitious wall and to stratify said mixture under centrifugal force to provide a cement rich outer wall layer and a polymer rich inner wall layer, said cementitious wall having an internal strata that is progressively richer in polymer from said outer layer to said inner layer and having radially interlocked continuums of cement and polymer;

curing said cementitious wall;

drying at least said inner layer to remove moisture from said polymer rich inner layer;

heating said inner layer to a polymer fusion temperature and applying a second quantity of polymer to said inner layer whereby a continuous polymer coating is formed on said cementitious wall.

In a further form there is disclosed a method for producing a cylindrical body having an internal cementitious wall with a continuous internal coating of polymer, said method comprising:

preparing a substantially homogenous mixture of cementitious mortar containing a first quantity of 1-23% by weight of polymer particles;

applying said mixture to the internal surface of a cylindrical form;

rotating said form at a speed sufficient to spread said mixture evenly across said internal surface to form a cementitious wall and to stratify said mixture under centrifugal force to provide a cement rich outer wall layer and a polymer rich inner wall layer, said cementitious wall having an intermediate strata that is progressively richer in polymer from said outer layer to said inner layer, said inner layer having an internal surface with polymer particles imbedded therein;

continuing said rotation of said form until said mixture has densified so as to produce a non-flowable cylindrical cementitious wall;

curing said cementitious wall for a period sufficient to develop strength and hardness of said cementitious mortar;

heating at least said inner layer of said cementitious wall to drive moisture out of said polymer rich inner layer and to raise the temperature thereof to about the fusion temperature of said polymer particles; and

applying a second quantity of polymer particles to said heated internal surface of said inner layer of said cylindrical cementitious wall whereby said second quantity of polymer particles melts and fuses to said polymer particles imbedded in said internal surface whereby a continuous polymer coating is formed on said internal surface of said cementitious wall.

The subject process may be practiced utilizing known apparatus to produce lined metal pipe, such as cement lined cast iron pipe; and is also applicable to the production of cement pipe and other products.

Thus from another aspect there is disclosed an improved cylindrical body having an internal cementitious coating with a continuous internal coating of polymer, said cylindrical body comprising:

a first cylindrical cementitious coating having a first outer gradient comprising substantially cement and a second outer gradient forming a cylindrical inner surface of mixed cement and first polymer substances imbedded therein with said first polymer substances in greater concentration near the inner surface of said second outer gradient; and

a second cylindrical continuous coating comprising substantially a second polymer material applied to said cylindrical inner surface and bonded directly to said first imbedded polymer substances of said second outer gradient.

From a further aspect there is disclosed an improved ferrous pipe having an internal coating of polymer, said pipe comprising:

a cylindrical shell;

a first cementitious coating having a first outer gradient comprising substantially cement adjacent said shell and a second outer gradient forming a cylindrical inner surface of mixed cement and imbedded first polymer substances, with said first polymer substances in greater concentration near the inner surface of said second outer gradient; and

a second continuous inner coating comprising substantially a second polymer material applied to said cylindrical inner surface and bonded directly to said imbedded first polymer substances of said cylindrical inner surface.

From yet a further aspect there is disclosed an improved ferrous pipe comprising:

a cylindrical ferrous shell having an inner surface, a cementitious inner coating formed on the inner surface of said cylindrical ferrous shell, said cementitious inner coating comprising a gradient of polymer enriched cement wherein said polymer increases in concentration in a radial direction inwardly from said cylindrical ferrous shell, said cementitious inner coating forming an inner cylindrical layer; and

a second polymer material forming an inside coating on said inner cylindrical layer.

Brief Description of the Drawings:

Further objects and advantages will become apparent upon reading the following detailed description of a preferred embodiment in conjunction with the drawings wherein:

FIGURE 1 is a flow diagram for the process of the present invention as applied to cast iron pipe;

FIGURE 2 is a cross sectional view of a coated cast iron pipe of the present invention; and

FIGURE 2A is an enlarged detail of a portion of FIGURE 2.

Detailed Description of the Invention:

According to the present invention a polymer is mixed with a cementitious mortar which is stratified and cured to produce a substrate having a polymer rich surface to which a substantially pure polymer coating may be fusion bonded. The technique is especially adaptable to the production of lined

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hollow products such as ferrous pipe, however, it will be readily understood that the technique hereafter described in detail is also applicable to the production of other lined pipes and to cement pipe as well as to tanks, storage vessels and other products. In the present description the terms polymer and polyethylene shall be understood particularly to include all densities of polyethylene and other olefin polymers or copolymers and combinations thereof, as well as other thermoplastics that are suitable for rotational molding, although high density polyethylene having a specific gravity of 0.91 - 0.97, e.g. 0.94, is preferred. Similarly the term cementitious shall be understood to include material having the properties of cement, which may comprise a kiln fired mixture of alumina, silica, lime, iron oxide and magnesia and may also include other materials including fillers such as sand.

The present method, as diagramed in FIGURE 1, involves the admixing of a minor amount ranging between about 1-23 percent by weight of a polymer into a cementitious mortar comprising cement, liquid (usually water) and filler (usually sand) to produce a batter that is sufficiently fluid to permit the mixture to be partially stratify between heavier and lighter components and thereby produce a substrate surface that is rich with imbedded polymer. The polymer is preferably introduced as solid particles ranging between minus 10 to plus 325 mesh. The step of stratifying may be accomplished by natural settling of the heavier components and may be facilitated by agitation, or in a preferred embodiment stratifying is achieved by applying centrifugal forces on the mixture by rotating a hollow product being lined with the mortar.

Prior to the application of a continuous polymer coating the forming of a cementitious substrate is followed by curing, to develop available strength and hardness characteristics, and drying to remove moisture from at least the polymer rich strata. Preferably drying is accomplished by heating the cementitious substrate to the polymer fusion temperature; and drying is immediately followed by applying a quantity of substantially pure polymer to the hot polymer rich surface to thereby obtain a tenacious bond between the imbedded and coating polymers.

Preferably both imbedded and coating polymers are of the same composition and the bond will be essentially a merging of like materials. However, different polymers will also firmly meld together.

The coated product is then cooled and inventoried for distribution.

The aforedescribed coating method was devised primarily for the manufacture of internally coated cement lined cast iron pipe which may range in nominal size from about 3 inch to 108 inch diameter and lengths of about twenty feet, which is the best mode known for practicing the invention. However, it will be apparent that the invention may be readily adapted to the manufacture of pipe made of other materials, including steel, other metal, cement or concrete and other products such as tanks, storage vessels and the like.

The production of polyethylene coated iron pipe by the aforedescribed process is particularly advantageous because it is otherwise difficult to reliably bond polyethylene to an iron surface. A characteristic of polyethylene is that it does not bond well to other materials. Heretofore the surface of iron pipe has been carefully prepared by abrading and cleaning to create a rough surface to which polyethylene may adhere. However, according to the present invention, as illustrated in FIGURES 2 and 2A, a continuous coating layer 10 of polyethylene coheres to polyethylene in the cementitious lining 12 and the latter is bonded to the iron pipe 14 by a well understood reaction between hydroxide in the cement and iron on the pipe surface. The cohesive bond between the polyethylene and cementitious layer is superior to any available polyethylene adhesion directly to metal.

The manufacture of cement lined cast iron pipe is a well developed industry and techniques and apparatus are well known for applying a cementitious mortar and spinning the pipe to form a uniform internally concentric wall or lining. (See for example U.S. patent 4,474,134). Fundamentally a twenty foot standard length of pipe of virtually any production diameter is rotated horizontally relative to an internal distribution apparatus which applies a mortar, pumped through a conduit connecting a mortar supply to the distributor, to the interior surface of the pipe. The pipe is also rotated about its longitudinal axis during and/or after application of the mortar to spread the mortar evenly into pipe surface irregularities and to release air bubbles so as to develop a cylindrical wall with a relatively uniform inner surface. The pipe is then stored for a period of time to enable the cement lining to cure. In most instances such cement lined pipe has been given an internal coating of bitumen, or the like, which adheres to the cement surface. Prior attempts to apply a polymer coating to such cement lined pipe have resulted in unacceptable delamination.

According to the present invention an internal polymer coating is bonded to the cement surface by first incorporating and imbedding a polymer composition in the cement wall or lining, which composition is selected to be bondable with the coating polymer. By bondable it is meant that the coating and imbedded polymers will meld rather than merely adhere. Thus it is preferred to utilize substantially the same polymer composition in both the mortar mix and the coating.

The bonding is enhanced by causing the cementitious interface to be relatively rich with imbedded polymer. That is accomplished by preparing a mixture of cementitious mortar and a lesser amount of polymer, preferably about 5-12 percent by weight of high density polyethylene in fine, 35-50 mesh, particle form. The mixture or batter may include a small excess of liquid, usually water so as to facilitate subsequent stratification of the cementitious internal pipe wall. However, it is preferred to adjust the batter composition to obtain sufficient fluidity with no or minimal excess liquid so as to avoid loss of polymer when draining excess liquid from the lined pipe. The process continues by depositing the mixture on the interior surface of a pipe length or other form, as by pumping the mixture to a longitudinally movable applicator and extruding or slinging the mixture onto the pipe surface; and then stratifying the mixture, in place, so as to bring to the unconfined surface a preponderance of the admixed polymer. This is accomplished in pipe manufacture by spinning the pipe about its longitudinal axis at a rotational speed, and for a period of time, sufficient to cause the heavier cement and filler components to migrate and concentrate outwardly by centrifugal force thus leaving an internal strata that will be progressively richer in polymer toward the internal surface. However, the spinning should not be conducted under conditions to cause complete stratification as it is desired to have a cementitious wall with radially interlocked continuums of cement and of polymer so as to obtain strength and hardness as well as roots to polymer bonding sites. Normally spinning for a period of about one to two minutes at a rotational speed selected to develop a force of between five and one hundred fifty gravities (5-150G) will be sufficient. However, greater forces of up to about 1,300 G may be utilized depending on the fluidity of the mixture.

Spinning may be followed by removing any excess free liquid that may be expelled from the batter mixture. This may be accomplished by tilting the pipe and draining the free liquid from the lower end.

Curing of the cementitious wall or lining is then obtained by storing the pipe, usually for a number of days, until the cement becomes hard and strong. Thereafter a separate step of drying is conducted to rid the cementitious lining of uncombined moisture that is entrapped in its slightly porous structure. Such drying is conveniently accomplished by heating and increasing the temperature of the pipe and/or the cementitious inner wall; and such heating is continued until the inner surface reaches its polymer fusion temperature in the range of about 350°-600°F. Immediately thereafter the pipe interior is coated by applying a second quantity of pure polymer, preferably the same composition mixed with the mortar, e.g. polyethylene, to the hot cementitious wall surface. This step may also advantageously utilize centrifugal forces by again spinning the pipe about its longitudinal axis while uniformly introducing polymer particles along the pipe length. The second quantity of polymer is in an amount calculated to produce the desired coating thickness, e.g. 8 to 60 mil., throughout the pipe length. Thereafter the coating step is followed by cooling and the finished pipe is then shipped or inventoried for future use.

Example I

A test was conducted on 10 inch dia. 18 foot length of cast iron pipe by applying a mortar mix comprising (by weight) 41.3% silica sand, 33.8% LEHIGH brand Portland cement; 6.0% PLEXAR 232 brand Polyethylene (35 mesh particles having .94 sp.gr. supplied by Quantum Chemical Corp.), and 18.9% water. Volumewise the polyethylene comprised about 15% of the mortar mix. The pipe with mortar mix was spun for two minutes attaining a top speed of 1080 r.p.m. (producing a force of about 150G.) and then allowed to cure for one week. Thereafter the pipe was oven heated to 550°F and 5 pounds of the same polyethylene composition was rotationaly cast onto the hot internal surface to produce a coating 20 mil. thick. The resultant coating was firmly bonded, smooth and free of voids or holidays.

Example II

A satisfactorily lined and coated cast ductile iron pipe of 10 inch inside diameter was prepared with a mortar mix comprising (by weight) 38.1% sand, 31.1 cement, 19.7% water and 11.1% polyethylene powder. Volume wise the polyethylene comprised about 25% of this mortar mix. The pipe was spun, cured and coated as in Example I Similarly the resultant coating was firmly bonded, smooth and free of voids or holidays.

Example III

Another 10 inch diameter pipe was lined and coated by first applying a mortar mix comprising (by weight) 36.4% sand 32.5% cement, 23.1% water and 8.0% polyethylene powder. The pipe was spun, cured and coated as in Example 1 with similar results.

Further variations and modifications may be made in the process and product without departing from the spirit and scope of the invention which is defined in the following claims:

The claims defining the invention are as follows:

1. A method for producing a cylindrical body having an internal cementitious wall with a continuous internal coating of polymer, said method comprising:

preparing a mixture of cementitious mortar containing a first quantity of powdered polymer material;

applying said mixture to the internal surface of a cylindrical form;

rotating said form at a speed sufficient to spread said mixture evenly across said internal surface to form a cementitious wall and to stratify said mixture under centrifugal force to provide a cement rich outer wall layer and a polymer rich inner wall layer, said cementitious wall having an internal strata that is progressively richer in polymer from said outer layer to said inner layer and having radially interlocked continuums of cement and polymer;

curing said cementitious wall;

drying at least said inner layer to remove moisture from said polymer rich inner layer;

heating said inner layer to a polymer fusion temperature and applying a second quantity of polymer to said inner layer whereby a continuous polymer coating is formed on said cementitious wall.

2. The method of claim 1 wherein said cylindrical form is a ferrous pipe.

3. A method for producing a cylindrical body having an internal cementitious wall with a continuous internal coating of polymer, said method comprising:

preparing a substantially homogenous mixture of cementitious mortar containing a first quantity of 1-23% by weight of polymer particles;

applying said mixture to the internal surface of a cylindrical form;

rotating said form at a speed sufficient to spread said mixture evenly across said internal surface to form a cementitious wall and to stratify said mixture under centrifugal force to provide a cement rich outer wall layer and a polymer rich inner wall layer, said cementitious wall having an intermediate strata that is progressively richer in polymer from said outer layer to said inner layer, said inner layer having an internal surface with polymer particles imbedded therein;

continuing said rotation of said form until said mixture has densified so as to produce a non-flowable cylindrical cementitious wall;

curing said cementitious wall for a period sufficient to develop strength and hardness of said cementitious mortar;

heating at least said inner layer of said cementitious wall to drive moisture out of said polymer rich inner layer and to raise the temperature thereof to about the fusion temperature of said polymer particles; and

applying a second quantity of polymer particles to said heated internal surface of said inner layer of said cylindrical cementitious wall whereby said second quantity of polymer particles melts and fuses to said polymer particles imbedded in said internal surface whereby a continuous polymer coating is formed on said internal surface of said cementitious wall.

4. The method of claim 3 including the step of rotating said cylindrical cementitious wall at a speed sufficient to spread said second quantity of polymer particles evenly across said internal surface of said cementitious wall.

5. The method of claim 4 wherein said first and said second quantities of polymer are substantially the same polymer composition.

6. The method of claim 4 wherein said cylindrical form is a ferrous pipe.

7. An improved cylindrical body having an internal cementitious coating with a continuous internal coating of polymer, said cylindrical body comprising:

a first cylindrical cementitious coating having a first outer gradient comprising substantially cement and a second outer gradient forming a cylindrical inner surface of mixed cement and first polymer substances imbedded therein with said first polymer substances in greater concentration near the inner surface of said second outer gradient; and

a second cylindrical continuous coating comprising substantially a second polymer material applied to said cylindrical inner surface and bonded directly to said first imbedded polymer substances of said second outer gradient.

8. The product of claim 7, wherein said first and said second polymer are the same composition.

9. The product of claim 7, wherein said second polymer is a polyethylene.

10. The product of claim 7, wherein said continuous coating is heat bonded to said second layer.

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11. The product of claim 7, wherein said cementitious coating is formed from a mortar mixture containing a filler, cement, water and a powdered polymer.

12. The product of claim 11, wherein said powdered polymer is present in an amount of about 1-23% by weight of said mortar mixture.

13. The product of claim 7, wherein said cementitious wall is formed from a mortar mixture containing sand, cement, water and a polyethylene.

14. The product of claim 13, wherein said polyethylene is present in an amount of about 1-23% by weight of said mortar mixture.

15. An improved ferrous pipe having an internal coating of polymer, said pipe comprising:

a cylindrical shell;

a first cementitious coating having a first outer gradient comprising substantially cement adjacent said shell and a second outer gradient forming a cylindrical inner surface of mixed cement and imbedded first polymer substances, with said first polymer substances in greater concentration near the inner surface of said second outer gradient; and

a second continuous inner coating comprising substantially a second polymer material applied to said cylindrical inner surface and bonded directly to said imbedded first polymer substances of said cylindrical inner surface.

16. The product of claim 15, wherein said first and said second polymer substances are the same composition.

17. The product of claim 15, wherein said second polymer is a polyethylene.

18. The product of claim 15, wherein said continuous inner coating is heat bonded to said second layer.

19. The product of claim 15, wherein said cementitious coating is formed from a mortar mixture containing a filler, cement, water and a powdered polymer.

20. The product of claim 19, wherein said powdered polymer is present in an amount of about 1-23% by weight of said mortar mixture.

21. The product of claim 15, wherein said cementitious coating is formed from a mortar mixture containing sand, cement, water and a polyethylene.

22. The product of claim 21, wherein said polyethylene is present in an amount of about 1-23% by weight of said mortar mixture.

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23. An improved ferrous pipe comprising:

a cylindrical ferrous shell having an inner surface, a cementitious inner coating formed on the inner surface of said cylindrical ferrous shell, said cementitious inner coating comprising a gradient of polymer enriched cement wherein said polymer increases in concentration in a radial direction inwardly from said cylindrical ferrous shell, said cementitious inner coating forming an inner cylindrical layer; and

a second polymer material forming an inside coating on said inner cylindrical layer.

24. The improved ferrous pipe of claim 23, wherein said second polymer material forming said inside coating is bonded to said polymer in said cementitious inner coating.

25. A method for producing a cylindrical body having an internal cementitious wall with a continuous internal coating of polymer substantially as hereinbefore described with reference to the accompanying drawings.

26. The product of the method of any one of claims 1 to 6 or 25.

27. An improved cylindrical body having an internal cementitious wall with a continuous internal coating of polymer substantially as hereinbefore described with reference to the accompanying drawings.

28. An improved ferrous pipe having an internal coating of polymer substantially as hereinbefore described with reference to the accompanying drawings.

DATED this EIGHTH day of SEPTEMBER 1992

Amsted Industries Incorporated

Patent Attorneys for the Applicant
SPRUSON & FERGUSON

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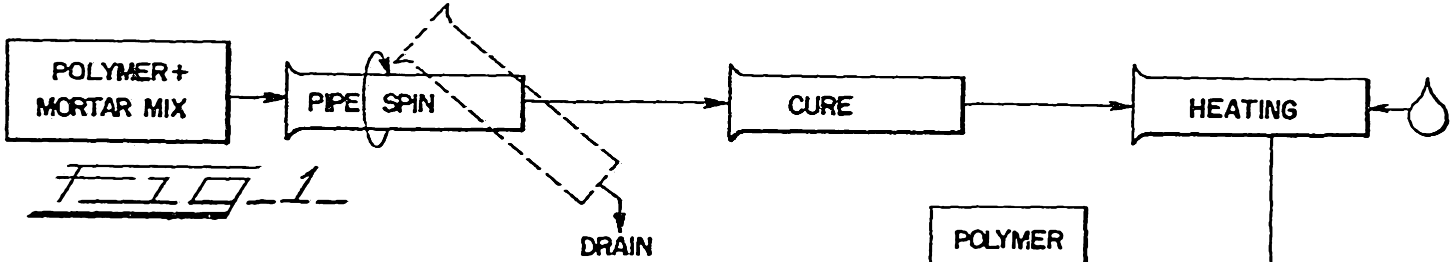

Fig_1_

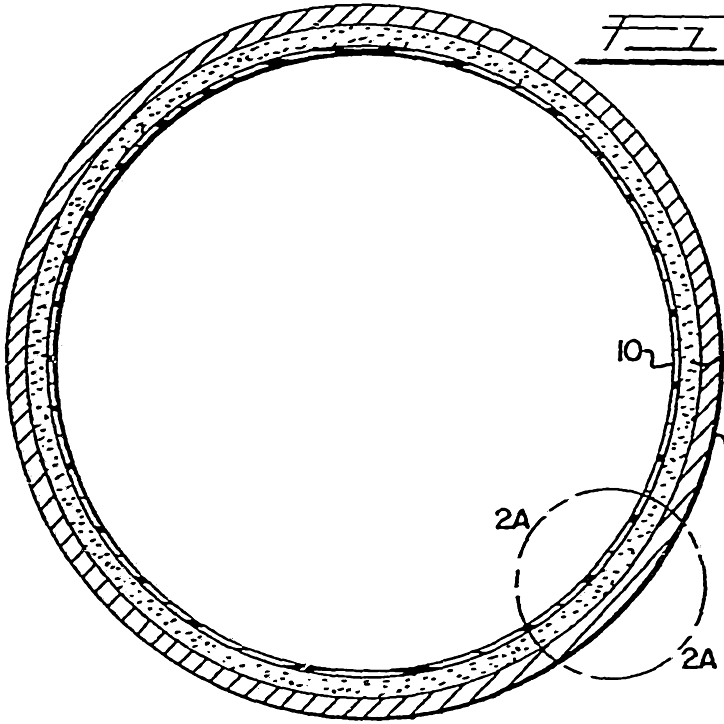

Fig_2_

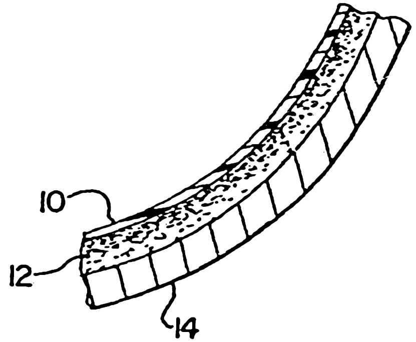

Fig_2A_

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