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Berry et al.

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[54] **COMPOSITE PIPE WRAP MATERIAL AND METHOD**

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[52] **U.S. Cl.** **138/146,** 138/144, 156/187, 156/195, 161/143, 161/156, 161/151

[51] **Int. Cl.** **B32b 1/10,** F16l 9/14

[58] **Field of Search** ..... 161/DIG. 4, 82, 89, 161/93, 95, 109, 110, 111, 156, 157, 170, 159, 161, 192, 205, 167, 202; 156/184, 187, 192, 215, 217; 138/144, 145, 146, DIG. 2

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[57] **ABSTRACT**

A composite pipe wrap material for underground pipe including a fiber glass pipe wrap material bonded to an outer protective pipe wrap material by a layer of adhesive which partially penetrates into the fiber glass wrap. The fiber glass wrap is preferably in the form of a mat. The composite pipe wrap material is adapted to position a portion of the fiber glass mat in approximately the outer one-third of the thickness of a metallic pipe protective coating when the material is wrapped about a metal pipe. Also disclosed is a method or protecting a metallic pipe by forming the composite pipe wrap material, coating the pipe with a protective coating and wrapping the pipe to position a portion of the fiber glass wrap in approximately the outer one-third of the thickness of the coating. Further disclosed is a method of positioning a portion of fiber glass pipe wrap material in approximately the outer one-third of the thickness of a protective coating on a metallic pipe.

18 Claims, No Drawings

COMPOSITE PIPE WRAP MATERIAL AND METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to pipe wrap materials and a method of making and using the same. More particularly, this invention relates to wrapping pipe intended for underground use.

2. Description of the Prior Art

For many years, pipe, particularly pipe intended for underground use, has been protected with pipe coating materials and pipe wrapping materials. Particularly with metal pipe intended for underground use, such as steel pipe, pipe coating and wrapping materials have been applied to the pipe to prevent corrosion. Pipes of a wide range of diameters have been protected in this manner and have been used to transport oil. natural gas, gasoline water, and other fluid materials.

Underground pipe has been coated and wrapped both in the field and in the plant. A typical manner for protecting underground steel pipe has been to clean the pipe, apply a primer, applying an enamel coating, typically about 3/32 inch thick, and then wrap the pipe with a covering material. Depending upon the specific use and intended location of the pipe, the pipe has been given particular coating and wrapping treatments. These include a single-coat, single-wrap treatment in which the single coat of enamel and a single wrap of outer pipe wrapping have been applied to the pipe; a single-coat, double-wrap treatment in which an additional wrap is placed over the first wrap without an intermediate enamel coating and a double-coat, double-wrap treatment in which a second enamel coating is applied over the first wrap before the second wrap is applied. Additional layers of coatings and wraps have also been used in some instances. The coatings should be applied hot as thin, continuous layers covering the entire outer surface of the pipe and the wraps should be spirally wound over the coatings with adequate overlapping. Presently, the coating materials most frequently used are coal tar pitch enamel and asphalt enamel, with the primers chosen to be compatible with the enamel. The purpose of the enamel coating is to resist the attack of corrosion by providing an impervious, electrically-resistant protective skin around the pipe. The primary purpose of the wrapping is to protect the enamel from damage both during and following placement in the ground. The most generally used wrapping materials have been saturated asbestos felt and fiber glass mat. Asbestos felt, saturated with either coal tar or asphalt, has been used as a protective shield for the pipe coating as the outer protective wrap due to its strength and resistance to soil chemicals, rotting and decay. Fiber glass mat is used to provide internal reinforcement for the enamel coating in order to increase resistance to physical damage. The mat helps strengthen the enamel coating and holds it in place against gouging, impact, and backfilling as well as soil stresses. This wrap usually comprises a mat made of an open network of fine glass fibers held together by a binder and it may be reinforced by spaced longitudinally-extending glass yarn. The fiber glass wrap is applied while the enamel is hot and it is pulled into the enamel before the enamel cools or sets.

One of the most commonly used combinations of pipe protection is a first enamel coating followed by a wrap of fiber glass mat, a second enamel coating and then an outer protective wrap, usually saturated asbestos felt. As previously mentioned, the pipe may be coated and wrapped in the field or in the plant. When the pipe is coated and wrapped in the field, a machine is used to clean and prime the pipe. A line traveling coating and wrapping machine is then used to apply the enamel and the wrap(s). This machine, which surrounds the pipe and moves over it, applies a uniform coating of hot enamel on the exterior pipe surface and then wraps the pipe with the chosen pipe wrap while the enamel is hot. The pipe wrap is stored on rolls or spools which are rotated about the pipe and which apply a spiral wrap thereto. The tension on the rolls is adjusted to provide the desired smooth and uniform covering with the specified lap width. Particularly with fiber glass wrap, it is important to properly adjust the tension on the rolls so that the wrap is drawn into contact with the enamel, the enamel penetrating therethrough to provide an effective bond for the overlying wrap. The pipe coating and wrapping operation in the plant is performed on equipment which rotates the pipe, coats the rotating pipe with enamel and spirally wraps the rotating pipe with pipe wrap down from fixed rolls. Tensioning of the rolls is also important in the plant application to properly draw the fiber glass wrap into contact with the enamel and to provide a smooth, uniform wrap.

After the pipe has been coated and wrapped for protection, it is usually given an electrical inspection by an electrical "holiday detector" which detects "holidays" or defects in the protective coatings. If any defective spots are discovered, they are repaired. The pipe is then inserted into a ditch which has been dug and the ditch is subsequently backfilled. It should be apparent that if the pipe protection fails while the pipe is buried and corrosion begins, removal and repair of the damaged pipe is expensive. It is therefore important to initially provide the pipe with sufficient protection to resist corrosion. In addition, due to the considerable amount of underground pipe which may be used in one installation, it is also important to limit the cost of the pipe protection materials and application.

Failures in the pipe protection have occurred in the past, resulting in pipe corrosion and the necessity for removal and repair. Inspection of such pipe has given the industry clues as to the causes of such failures. With pipe that has been wrapped with fiber glass mat and an outer protective wrap, inspection has revealed that in many instances when failures have occurred, the fiber glass mat was embedded in the enamel coating in a position relatively close to the pipe surface. It has been generally agreed that the fiber glass wrap should be embedded in about the outer one-third of the thickness of the enamel coating, away from the pipe, in order to provide the optimum reinforcement for the enamel and reduce the incidence of failure of the pipe protection. Fiber glass mat positioned closer to the pipe surface than about the outer one-third of the thickness of the enamel coating has little, if any, effect as a reinforcement. It is thought that since the stress is greatest in the outer third of the enamel thickness, by providing fiber glass reinforcement in that location the reinforcement can limit the penetration or propagation of cracks, breaks or ruptures in the enamel surface toward the pipe surface.

Although care has been taken to properly position the fiber glass wrap in the enamel coating, due to mechanical problems and low viscosity of the hot enamel it is not uncommon to find the fiber glass relatively close to the pipe surface. The mechanical problems are primarily associated with improper tensioning of the wrap rolls, which is more of a problem during field applications of the wrap rather than factory application due to the rotating rolls in the former application. If the tension is too high, the fiber glass wrap is embedded too deeply into the enamel and if the tension is too low, improper and non-uniform application of the wrap may occur.

OBJECTS OF THE INVENTION

It is an object of the invention to provide a pipe wrap material for underground pipe.

It is another object of the invention to provide a pipe wrap material which includes fiber glass pipe wrap and which, when wrapped about a pipe, provides protection for such pipe.

It is a further object of the invention to provide a pipe wrap material which includes fiber glass pipe wrap and which, when wrapped around a pipe, positions the fiber glass pipe wrap in a desired location.

It is an additional object of the invention to provide a method of protecting a pipe with such pipe wrap material.

It is another object of the invention to provide a method of positioning a portion of fiber glass pipe wrap material in approximately the outer one-third of the thickness of a protective pipe coating.

These and other objects will be apparent to those skilled in the art from the description which follows.

SUMMARY OF THE INVENTION

A pipe wrap material for underground pipe is provided which includes fiber glass pipe wrap and which, when wrapped around the pipe, properly positions the fiber glass wrap. It has been found that the fiber glass pipe wrap material can be properly positioned in the protective or enamel coating by pre-laminating the wrap to an outer protective wrap with a layer of laminating adhesive. The surface of the fiber glass wrap opposite from the outer protective wrap is substantially free from the laminating adhesive so that sufficient bond and penetration into the hot enamel coating can be accomplished. The layer of laminating adhesive is thought to act as a shielding or barrier layer, preventing further penetration of the hot enamel coating. When this composite pipe wrap material is applied to the pipe, the fiber glass wrap is prefixed in that portion of the enamel coating where it is most effective.

This invention further provides a method of protecting pipe intended for underground use by first laminating an outer protective wrap to a fiber glass pipe wrap and thereafter wrapping the pipe with the combined wrap. Additionally, this invention provides a method of positioning a portion of fiber glass pipe wrap material in approximately the outer one-third of the thickness of a protective pipe coating by laminating the fiber glass wrap to an outer protective wrap and wrapping the laminating adhesive-free surface of the fiber glass wrap about a coated pipe.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The pipe wrap material of this invention comprises a layer of fiber glass wrap pipe material laminated to an outer protective pipe wrap material. The fiber glass pipe wrap material preferably is a non-woven mat of glass fibers. However, fiber glass pipe wrap produced by textile operations (e.g., woven fiber glass fabrics) may alternatively be used. Although in this discussion reference may be primarily made to fiber glass pipe wrap material in the form of a mat, it should be understood that the description also applies to such other fiber glass pipe wrap materials. The fiber glass mat pipe wrap material is preferably similar to that presently used to wrap pipe. The mat may comprise an open network of fine glass fibers bonded with an adhesive, such as, for example, a phenol or urea-formaldehyde resin. Longitudinally-extending glass yarn reinforcement may be incorporated in the mat. The mat is sufficiently porous to allow the enamel coating to "bleed" into the mat when the mat is wrapped about the pipe. The porosity of the mat should be uniform in order to have the coating "bleed" into the mat evenly. The mat is usually thin, commonly between about 15 to about 25 mils nominal thickness, although the thickness may be chosen as desired. When this porous material is bonded to an outer protective wrap, it is compressed and is a small part of the overall thickness of the composite wrap.

Bonded to the fiber glass mat is an outer protective wrap material. This material may comprise any conventional outer protective wrap, such as the commonly used asbestos pipe line felt. This felt comprises a sheet of asbestos fibers saturated usually with coal tar or asphalt. The saturant is usually chosen to be compatible with the enamel that is applied to the pipe. The amount of saturant, as measured by desaturation percent, may be, for example, between about 18 to about 40 percent by weight. The thickness of the felt may be, for example, between about 18 to about 30 mils. The felt may be perforated or non-perforated and may be provided with parallel glass yarn reinforcement.

The fiber mat and the outer protective wrap are bonded by a thin layer of laminating adhesive. The adhesive layer may be typically about 5 mils thick. This laminating adhesive or enamel may be of a composition similar to that used as the enamel coating on the pipe. Preferred materials are coal tar or asphalt. The coal tar may be unplasticized, modified or simi-plasticized. As a specific example, the laminating adhesive may be coal tar having the following properties: softening point, 195°–205°F; penetration (77°F/100 grams/5 seconds), 2–7; flash point, +450°F; percent filler, 20–27. As a further specfic example, the laminating adhesive may be asphalt having the following properties: softening point, 210°–220°F; penetration (77°F/100 grams/5 seconds), 15–29; flash point, +450°F; percent filler, 25–35. The particular laminating adhesive chosen should be compatible with the enamel coating applied to the pipe; coal tar may be used as the laminating adhesive when coal tar enamel coating is applied to the pipe and asphalt adhesive may be used with asphalt coating enamel.

The layer may be laminated by applying a thin layer of the laminating adhesive to one surface of the outer protective wrap, for example the upper surface of a

traveling web of the outer protective wrap material. The fiber glass mat material, for example drawn from a roll of such material, may then be brought into contact with the laminating ahesive, with one surface contacting the adhesive, and the layers pressed together by means, for example, of rolls in order to press the fiber glass mat into the layer of adhesive to a limited extent. Other methods of bonding the layers together could be used. The laminating adhesive should be applied hot as a continuous uniform film and should be permitted to penetrate into but not to strike through the fiber glass mat. The surface of the fiber glass mat opposite from that surface adhered to the outer protective wrap should be substantially free from the adhesive which bonds the layers together. Put in another way, the fiber glass mat should be only partially embedded in the adhesive and not completely saturated by the adhesive. Thus, at least a surface of the mat as well as a portion of the mat interior adjacent such surface is substantially free from the laminating adhesive. By providing an adhesive-free surface on the fiber glass mat, the mat remains in a sufficiently porous state so as to provide anchoring areas into which the hot enamel coating on the pipe can flow when the combined pipe wrap material of this invention is wrapped around the pipe.

In a preferred embodiment, the thickness of the composite pipe wrap material may be between about 20 to about 30 mils.

The laminated pipe wrap is preferably spirally wound about the pipe in the conventional manner, whether in the field or in the plant, after the laminating adhesive has cooled, with the laminating adhesive-free surface being placed inwardly against the coated pipe surface and the outer wrap material being exposed. The inner, adhesive-free surface of the fiber glass mat is brought into contact with the hot enamel coating and is partially embedded therein. The enamel coating penetrates into those areas of the fiber glass mat which are porous and substantially free from laminating adhesive to a distance up to the location of the laminating adhesive, coming into contact with such adhesive. Any further substantial penetration into the fiber glass mat is prevented or blocked by the laminating adhesive. It is thought that the laminating adhesive acts as a shielding or barrier layer, controlling the amount of penetration of the enamel into the mat such that strike through or complete "bleed" through of the enamel is prevented. In this manner, when the composite pipe wrap is wrapped about a pipe coated with hot enamel, the enamel enters into the fiber glass component to a limited extent and bonds thereto. This limited extent is approximately predetermined by a compressed thickness of the fiber glass mat and the depth of penetration of the laminating adhesive and is chosen to be less than about one-third of the thickness of the enamel coating. For example, with an enamel coating of approximately 3/32 inch thick, the thickness of the compressed mat and the depth of penetration of the laminating adhesive are chosen to allow a maximum amount of about one thirty-second inch of the enamel to penetrate into the mat. This assures proper positioning of a portion of the mat in approximately the outer one-third of the thickness of the enamel coating without the mat being embedded in approximately the lower two-thirds of the enamel coating thickness. After being wound about the pipe, a portion of the fiber glass mat extends above the enamel coating, the remaining portion is embedded in the coating to a thickness not greater than approximately one-third of the thickness of the enamel coating and approximately the lower two-thirds of the coating does not contain the fiber glass mat material. The enamel coating, as well as the laminating adhesive which may be of a similar composition and which penetrates the fiber glass mat, provide the pipe with the required protection from corrosion.

It should be apparent that when the composite pipe wrap is unwound from a roll and is wrapped about the pipe, the fiber glass mat itself is not subjected to a tension force which could tend to force or pull the mat deeply into the enamel coating, as could occur if the pipe were wrapped with separate rolls of fiber glass mat and outer protective wrap. Rather, the composite pipe wrap is subjected to a tension force and because the two wraps are laminated together, their relative positions are pre-set and fixed and the tendency of the fiber glass mat to be pulled deeply into the enamel coating is eliminated or greatly reduced. Of course, tension on the composite pipe wrap spool should not be so great as to force the enamel coating to any appreciable degree out from under the pipe wrap and laterally away therefrom along the longitudinal axis of the pipe, with the result that the thickness of the protective enamel coating would be reduced to an undesirably thin amount.

The combined pipe wrap material of this invention has been found to be an effective protective covering for underground metallic pipe, preferably steel pipe, and provides a "pre-fixing" of the fiber glass mat in the enamel coating due to the pre-lamination of the component layers and partial impregnation of the fiber glass mat. The wrap of this invention has also produced surprising improvements in the wrapping operation. Because the pipe wrap materials are combined in one composite wrap which may be wound on one spool of a two-spool coating and wrapping machine, the second spool is capable of being provided with a second roll of the composite pipe wrap. Becuase such spool contains the composite wrap, it is possible to approximately double the speed of application of the covering materials while maintaining sufficient protection for the pipe and enamel coating. In addition, it has been found that with the composite pipe wrap material of this invention, less enamel need be applied to the pipe. A typical conventional pipe enamel coating thickness is about three thirty-seconds inch. It has been found that when applied in conjunction with the composite wrap of this invention, the pipe enamel coating need only by about 5/64 inch and still provide the necessary protection. The saving in enamel coating may be considerable when it is realized that several miles of pipe may have to be coated and wrapped in one installation. It is thought that less pipe enamel coating need be applied to the pipe because the laminating adhesive which extends into the fiber glass mat, being of a composition similar to that of the pipe enamel coating, also provides corrosion protection for the pipe.

Although in the above disclosure of the invention reference has been made to fiber glass mat pipe wrap material, mats or other wraps materials made of other fibers having the desirable properties of glass, such as strength, resistance to decay and capability of being embedded in pipe enamel coating, may be incorporated in a composite pipe wrap material for wrapping about metallic pipe and positioning a portion of such

materials within approximately the outer one-third of the thickness of the protective coating.

It is to be understood that other variations and modifications of the present invention may be made without departing from the spirit of the invention. It is also to be understood that the scope of the invention is not to be interpreted as limited to the specific embodiment disclosed herein, but only in accordance with the appended claims when read in light of the foregoing disclosure.

What is claimed is:

1. A composite pipe comprising:

a. fiber glass pipe wrap material,

b. outer protective pipe wrap material bonded to one surface of said fiber glass wrap by a laminating adhesive which partially penetrates into said fiber glass wrap, the other surface of said fiber glass wrap being substantially free from the laminating adhesive thereby retaining a porous structure,

c. said pipe wrap material being wrapped about a metallic pipe which has been coated with a protective coating, with said laminating adhesive-free surface of said fiber glass wrap being penetrated by and embedded into said protective coating and with said adhesive being in contact with but unpenetrated by said protective coating, whereby a portion of said fiber glass wrap is located in approximately the outer one-third of the thickness of said protective coating.

2. The article of claim **1** wherein said fiber glass pipe wrap material is fiber glass mat.

3. The article of claim **2** wherein said outer protective pipe wrap material is asbestos felt.

4. The article of claim **3** wherein said asbestos felt is saturated with a saturant selected from the group consisting of coal tar and asphalt.

5. The article of claim **4** wherein said outer protective pipe wrap material and said fiber glass mat pipe wrap material are bonded by a thin layer of laminating adhesive selected from the group consisting of coal tar and asphalt.

6. The article of claim **5** wherein said laminating adhesive comprises unplasticized, modifed or semiplasticized coal tar.

7. The article of claim **5** wherein said fiber glass mat comprises an open network of glass fibers bonded with an adhesive.

8. The article of claim **5** wherein said saturated asbestos felt includes parallel glass yarn reinforcement.

9. The article of claim **5** wherein said metallic pipe is steel pipe and said protective coating is selected from the group consisting of coal tar enamel and asphalt enamel.

10. The article of claim **9** wherein said protective coating is about 5/64 inch thick.

11. A method of protecting a metallic pipe, intended for underground use, from corrosion comprising:

a. bonding one surface of a layer of pipe wrap material comprising fiber glass to a layer of outer protective pipe wrap material with a laminating adhesive which partially penetrates into said fiber glass pipe wrap thereby forming a composite pipe wrap, the other surface of said fiber glass pipe wrap being substantially free from said laminating adhesive and retaining a porour structure,

b. coating and pipe with a protective coating,

c. wrapping said pipe with said composite pipe wrap with said laminating adhesive-free surface of said fiber glass pipe wrap being placed in contact with said protective coating, said surface being penetrated by and embedded in said coating, said laminating adhesive being in contact with but unpenetrated by said protective coating a portion of said fiber glass pipe wrap being positioned in approximately the outer one-third of the thickness of said coating and approximately the lower two-thirds of the thickness of the coating being free of said fiber glass pipe wrap material.

12. The method of claim **11** wherein said fiber glass wrap material is fiber glass mat.

13. The method of claim **12** wherein said fiber glass mat pipe wrap material and said outer protective pipe wrap material are bonded with a layer of laminating adhesive selected from the group consisting of coal tar and asphalt.

14. The method of claim **13** wherein said adhesive comprises unplasticized, modified or semi-plasticized coal tar.

15. The method of claim **13** wherein said outer protective wrap is saturated asbestos felt.

16. The method of claim **14** wherein said protective coating is selected from the group consisting of coal tar enamel and asphalt enamel.

17. A method of positioning a portion of fiber glass mat pipe wrap material in approximately the outer one-third of the thickness of a protective coating applied to a metallic pipe intended for underground installation, with approximately the lower two-thirds of the coating thickness being free of fiber glass mat, comprising:

a. laminating one surface of said fiber glass mat pipe wrap material to a layer of outer protective pipe wrap with a thin layer of laminating adhesive to form a composite wrapping material, the other surface of said fiber glass mat being substantially free from the laminating adhesive and retaining a porous structure, and

b. wrapping a metallic pipe coated with a protective coating with said composite wrapping material, said laminating adhesive-free surface being penetrated by and embedded into said coating, said coating extending into the pores of said fiber glass mat, said laminating adhesive being in contact with but unpenetrated by said coating, a portion of said fiber glass mat pipe wrap material being positioned in approximately the outer one-third of the thickness of said coating.

18. A pipe arrangement comprising:

a. a pipe having a protective coating on its external surface;

b. a composite pipe wrap material for wrapping said pipe, said pipe wrap mateial including;

i. a layer of fiber glass material having a first surface and a second opposite surface,

ii. a layer of outer protective wrap material, and

iii. a layer of laminating adhesive material for bonding said layer of adhesive material to said first surface of said layer of fiber glass material, said adhesive material being disposed between said fiber glass material and said protective wrap material; and

c. said composite wrap material being wrapped around said coated pipe such that said second surface of said layer of fiber glass material is penetrated by at most approximately the outer one-third portion of said protective coating and such that said adhesive material is in contact with but unpenetrated by said coating.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,757,829 Dated September 11, 1973

Inventor(s) George William Berry, Milton Wesley Gregory, and John Louis Ambrose

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 23, "applying" should read --apply--. Column 2, line 24, "down" should read --drawn--. Column 4, line 58, "29" should read --19--; line 66, "layers" should read --layer--. Column 5, line 53, "a" should read --the--. Column 6, line 63, "wraps" should read --wrap--; line 41, "Becuase" should read --Because--. Column 7, line 68, "and" should read --said--. Column 8, line 7, "coating" should read --coating,--; line 13, "fiber glass" should read --fiber glass pipe--; line 52, "mateial" should read --material--; line 57, delete "adhesive" and insert --protective wrap--.
Column 6, line 41, "such" should read -- each -- .

Signed and sealed this 20th day of August 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents