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Kemp et al.

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[54] **CASING PIPE AND METHOD OF CASING A BOREHOLE**

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[51] **Int. Cl.** **E21b 43/00**

[58] **Field of Search** ..... 166/315, 314, 242, 305 D; 138/145, 146; 285/55

[56] **References Cited**

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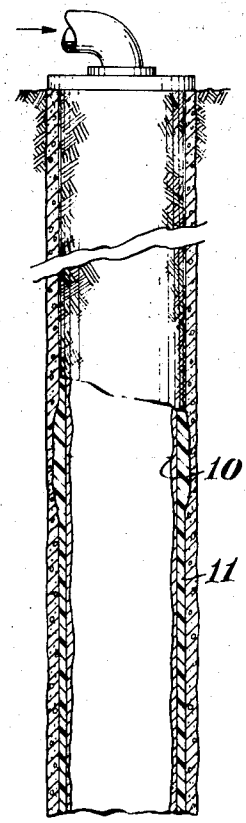
[57] **ABSTRACT**

An article of manufacture and its use for casing boreholes used for transporting corrosive fluids is taught. A metal casing pipe is provided with a coating of a set resinous material having incorporated therein fibrous reinforcements. The so-coated casing pipe is placed in the borehole and when the steel is corroded away a reinforced resinous casing remains.

9 Claims, 3 Drawing Figures



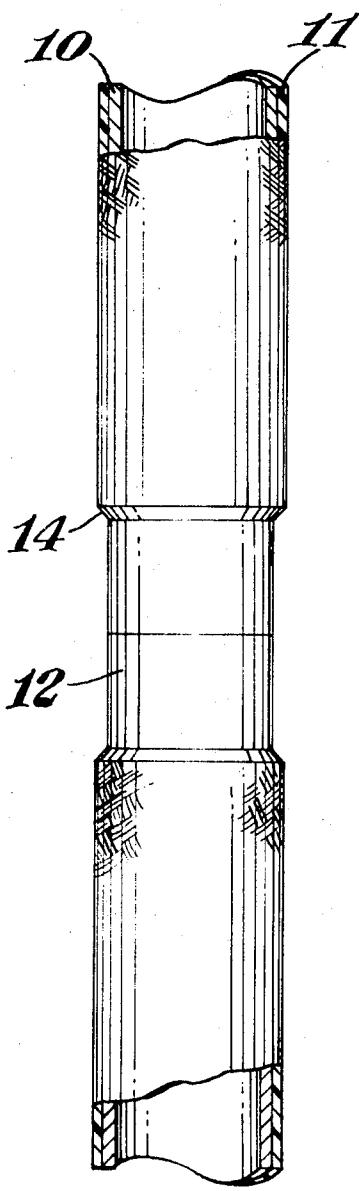


Fig. 1

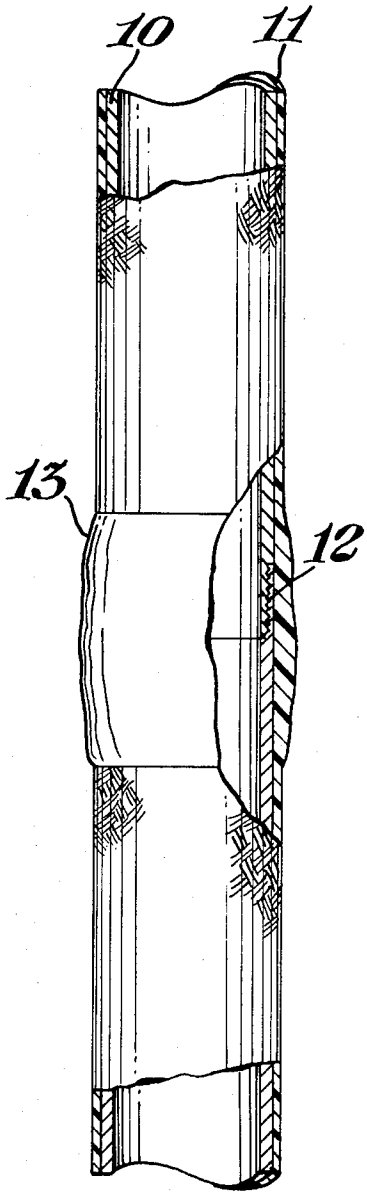


Fig. 2

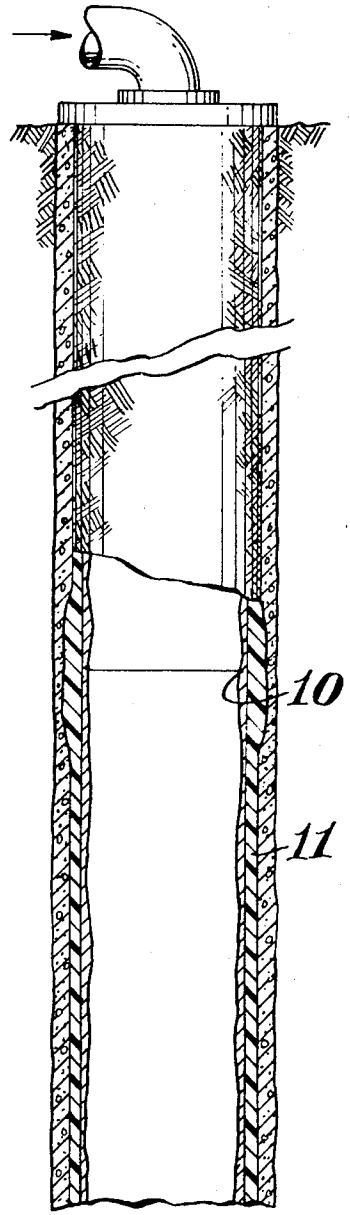


Fig. 3

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CASING PIPE AND METHOD OF CASING A BOREHOLE

BACKGROUND OF THE INVENTION

Boreholes employed to transport corrosive fluids, e.g., brines, from or into subterranean formations and/or caverns are normally cased with steel pipe which is held in place by filling the annulus between the pipe and hole with casing cement.

In the past these steel casing pipes were readily attacked by the corrosive constituents of the fluid. Attempts have been made to reduce the rate at which the casing pipe is corroded by employing corrosion inhibitors of many types. Also the pipes have been lined with various materials which themselves resist corrosive attack. However, neither of these methods have met with complete success and the steel casing pipe has to be periodically replaced, rebuilt, relined or the borehole may be completely abandoned.

SUMMARY OF THE INVENTION

In the practice of the present invention normally employed steel (or other commonly employed metal) casing pipe is coated on the outside with a material which is highly resistant to corrosive attack by the material circulated through the borehole and sufficiently strong so as not to collapse once the steel casing pipe is dissolved away. The steel casing pipe is employed as a sacrificial support member. The so coated pipe is cemented into a borehole in a normal manner. After in place a corrosive fluid is allowed to pass therethrough and the steel casing pipe is corroded away leaving the coating material as the transporting conduit. The corrosive fluid can be the fluid which is to be stored or recovered from a subterranean formation or a special fluid can be used. The metal pipe can be substantially completely dissolved away prior to the transportation of the corrosive fluid which is to be normally transported therethrough. Thus it is evident that although the novel casing pipe has particular utility in casing boreholes through which highly corrosive fluids are to be transported it can be employed to case other types of bores, for example, those used in oil and gas wells, water wells and the like.

The methods and apparatus employed to case boreholes with steel pipes, and the cement compositions employed to support the same are well known in the oil, gas and brine well industry. Further elaboration on these techniques and composition need not be made. For general information on the methods and compositions reference may be had to such literature as Craft, Holden and Graves, Well Design: Drilling and Production, Chapters 2–4, (1962) and the publications cited therein as references.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 illustrates a portion or two casing pipes joined together, each having been partially coated with a reinforced resinous material.

FIG. 2 illustrates the same two pipes illustrated in FIG. 1 wherein the exposed joint has been also wrapped with the resinous material prior to being emplaced in the borehole.

FIG. 3 illustrates the use of the novel article in a borehole with a portion of the metal casing pipe having been corroded away.

DETAILED DESCRIPTION OF THE INVENTION

The coating material employed in the practice of the present invention is any material which can be successfully bonded to the outside of the casing pipe, which upon the dissolution of the pipe is sufficiently strong to maintain its integrity as a liner, and which is substantially completely chemically inert to the action of the corrosive fluid flowing therethrough. Preferably, the coating is composed of a fibrous reinforced resin. The fibrous reinforced resin is a composite made by incorporating fibrous reinforcements into a resinous matrix. The matrix provides a means for binding the reinforcements together and for transmitting the load to the reinforcements.

Any resin can be employed which has the properties hereinbefore taught. Exemplary materials include thermo-setting and thermoplastic resins such as, for example, polyesters, phenolics, epoxides, silicones, dialkyl phthalates, alkyds, melamine, fluorochemical resins, polycarbonates, acrylic, acetals, polypropylene, polyethylene, polyimides, polybenzimidazoles and the like.

The fibrous reinforcements can be, for example, glass, cotton, asbestos, hard natural fibers, e.g. sisal, jute, etc., or synthetic fibers, e.g. rayon, nylon or the like.

Inert fillers may be added to the resinous matrix to make the composite less expensive; to strengthen the composite; to decrease the shrinkage thereof; to reduce its thermal expansion; to improve its heat resistance; to reduce its porosity or the like. Exemplary of such inert fillers include particulate, alumina, asbestos shorts, calcium carbonate, calcium silicate, cellulose flock, glass beads and spheres, graphite, baked carbon, iron oxide, magnesia, mica, silica, titanium dioxide, various clays and the like.

The outer surface of coating can be roughed or a particulate material embedded thereon to provide for a better bond between the cement employed to hold the casing in the borehole and the coating. For example, during the manufacture of the casing pipe, sand or other inert particulate material can be placed on the surface of a resinous material prior to its final set to provide a rough surface.

The coated steel casing pipe can be made in any suitable manner. For example, it can be fabricated by the filament winding technique. In this technique the casing pipe is wound with a continuous filament of reinforcement which is either submerged in a resinous matrix as it passes to the casing pipe or is previously coated with the required resin and the resulting coated pipe is cured (usually under elevated pressure) to give the final product. The coated casing pipe may also be prepared by building up a composite plate by means of bonding fibrous mats (either woven or non-woven) with a suitable resin which is usually cured with heat under pressure. Both of these techniques are well known in the art of preparing plastic reinforced pipes, containers and the like.

As illustrated in FIGS. 1 and 2 in a preferred embodiment, each section of a casing pipe **10** is coated with the reinforced resinous material **11** over the entire length thereof except for an area near each joint **12**. This area is left uncoated so that the casing pipe may be handled with normal casing equipment without destroying the resinous coating, prior to placing the

casing pipe into position in the borehole. However, in applications where such destruction will not occur the entire length of the pipe may be coated. After two casing pipes have been joined together the exposed area around the joint is coated with a reinforced resinous material 13 which is cured prior to placement into the borehole. As an aid in assuring a substantially continuous resinous coating the first coated portion of the casing pipe can be beveled 14 around the ends near the joints so that an overlap of reinforced resinous material can be made at the joints.

The thickness of the resinous coating will vary depending on the environment of the borehole (e.g. heat, pressure, etc.) and on the type of resin and the kind of fibrous reinforcement employed. Generally, however, a coating ranging from about ⅛ to about ½ inch thick is suitable. The thickness of the particulate coating employed should be sufficient to withstand the pressures exerted in a borehole once the metal pipe is dissolved away.

EXAMPLE

As an example of the article and method of the present invention a borehole (8400 feet deep and cased with steel pipe) connecting the surface of the ground with a brine disposal well was cased in the following manner.

The outside of steel casing pipes having a length of about 32 feet and a 6 ⅝ inch outside diameter were cleaned to remove oil and the like. Each length was then coated with a 5/16 inch thick layer of a vinyl ester resin reinforced with glass fibers. The entire surface of each section of pipe was coated with the resinous coating except for an are 30 inches from the female end and 18 inches from the male end. Prior to curing the resin its surface was coated with sand. After curing, the coating near each exposed joint was tapered with a sander.

The casing pipe was installed in the borehole in the following manner:

Three sections of coated casing pipe were joined together (threaded and torqued to provide two joints) and lowered into the hole. A fourth section was then threaded and torqued and this exposed joint was wrapped with a reinforced resinous material in the following manner. The resin was the same employed originally to coat each section of pipe. The reinforcement was glass fiber. The joint was overwrapped with the resin and the glass and then cured with a heat gun. The casing pipe was then pulled out of the hole to expose the second joint which was coated in the same manner as the first, and then pulled out further to perform the same operations on the third joint. This entire string was then lowered into the hole and 4 other sections attached thereto with each joint being coated in the manner described above. The sequence was repeated until the entire 8400 feet was cased. Following the placement of the coated casing pipe the annulus between the coated pipe and wall of the cased borehole was cemented to hold the pipe in place. The cased borehole is being employed to transport a brine containing about 17 per cent by weight NaCl, about 15 ppm Cl_2 with a pH of about 1 to a storage cavern.

What is claimed is:

1. A method of casing a borehole which penetrates a subterranean formation and through which a corrosive fluid is transported which comprises:
   a. bonding to substantially the entire outside surface of a metal casing pipe prior to its being lowered into said borehole, a coating material having sufficient strength to maintain the integrity of the borehole after the metal pipe is removed and substantially chemically inert to the corrosive fluid,
   b. securing the casing pipe in the borehole, and
   c. chemically dissolving the inner metal pipe away to leave the coating as the primary casing in the borehole.

2. The method as defined in claim 1 wherein the borehole connects the surface of the earth with a subterranean formation containing a highly corrosive fluid.

3. The method as defined in claim 1 wherein the metal pipe is dissolved away by a corrosive fluid normally transported through the casing.

4. The method as defined in claim 1 wherein the metal pipe is substantially completely dissolved away prior to the transportation of said corrosive fluid therethrough.

5. The method as defined in claim 1 wherein the coating material is a resin.

6. The method as defined in claim 5 wherein the coating material also contains a fibrous reinforcement.

7. The method as defined in claim 1 wherein the coating material is a resin reinforced with a fibrous material.

8. The method as defined in claim 1 wherein the coating is a filament wound fibrous reinforced resin.

9. The method as defined in claim 1 wherein the casing pipe is secured in the borehole with cement.

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