



Capacitance Probe for Detection of Anomalies in Nonmetallic Plastic Pipe

Opportunity

The Department of Energy's National Energy Technology Laboratory (NETL) is seeking collaborative research and licensing partners interested in implementing United States Patent Number 7,839,282 entitled "Capacitance Probe for Detection of Anomalies in Nonmetallic Plastic Pipe."

Disclosed in this patent is an analysis of materials using a capacitive sensor to detect anomalies in nonmetallic plastic pipe through comparison of measured capacitances. The capacitive sensor is used in conjunction with a capacitance measurement device, a location device, and a processor to generate a capacitance versus location output for the detection and localization of anomalies within the nonmetallic material under test. The components may be carried as payload on an inspection vehicle that can travel through the interior of a pipe. Supporting components are solid-state devices powered by a low voltage on-board power supply, providing for use in environments where voltage levels may be restricted.

Overview

About one-third of the nation's gas distribution pipelines fabricated from polyethylene from the 1960s through the mid-1980s may be vulnerable to a phenomenon known as "brittle-like cracking." This phenomenon, which is characterized by cracks through the wall of a pipe with no visible sign of deformation, represents the second most frequent cause for failure of older plastic piping. Approximately 500,000 miles of pipeline still exist that could exhibit the problem. Literature searches, however, have revealed no satisfactory technique to detect flaws in nonmetallic or plastic pipelines, specifically in-situ.

The technique described in this patent represents a novel sensing device that can reliably and dependably detect flaws or abnormalities in plastic and other nonmetallic pipes. The device and its related application are based on capacitance measurements that can detect flaws in already buried plastic gas distribution pipelines. The device contains a probe that can be inserted into a pipeline to examine the spatial dielectric characteristics of the pipe walls. The probe employs a sensor that measures the capacitance (permittivity) of the pipeline wall. Defects are thereby indicated by the demonstrated variations in the capacitance of the nonmetallic or plastic material.

The capacitive sensor is arranged to facilitate an electric field that extends from a driven electrode to a ground electrode when voltage is applied across the electrodes. The sensor is placed very near to the nonmetallic or plastic material to monitor the material and identify anomalies. The sensor, along with a power supply, location measurement device, and a processor, is mounted on an inspection vehicle designed to travel through the interior of an entire pipe and conduct inspections on sections of pipes where their exterior surface is not accessible.

Significance

This capacitance probe device has the following advantages:

- It offers the only known technique to identify flaws and defects in nonmetallic or plastic pipelines installed prior to the mid-1980s
- The device has worked reliably and dependably during tests.
- The device's processor can monitor the location of the inspection vehicle as it travels through the length of the pipe.
- A number of capacitive sensors can be mounted on the inspection vehicle to allow more comprehensive inspection during a single pass down the length of the pipe.
- The processor has the versatility of providing direct capacitance and location readings or storing the information for later analysis.
- The capacitance measurement device, the processor, and the location device can be composed of solid-state devices that receive power from an on-board battery, such as a 9-volt alkaline or nickel metal hydride battery.

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