CORROSION PROTECTED CONDUIT SYSTEM

A conduit system having a sacrificial anode extending into a pipe casing through an end plate and located to lie within any water that collects in the casing. The anode is supported in part by a pipe support within the casing. Gas under pressure is supplied to the casing. A sacrificial anode is secured to the outside of the casing.

This invention relates to a corrosion protected conduit system particularly to a prefabricated conduit system. Prefabricated underground conduit systems have been widely used in such places as Army bases and college campuses. Frequently these systems are used to conduct steam from a central power plant to outlying buildings for heating purposes. In such an application, a steam-conducting pipe is disposed within a surrounding steel casing and held in spaced relationship with the casing. Tubes of heat insulating material as Fiberglas are around the pipes. The pipes in such systems may typically carry superheated steam at temperatures of 400° Fahrenheit and relatively high pressures.

On occasions, leaks occur in the fluid carrying pipes of such systems or in the casings. When this happens, a casing of a section of such an underground system becomes flooded. Because of the high temperatures involved, the water in the casing boils, causing the formation of steam, which is emitted at the ends of the flooded section. Many of these ends are in manholes, and the escaping steam makes it particularly difficult to reach and repair the leak. Furthermore, the presence of boiling water inside the steel casing quickly attacks the casing wall, which soon fails, sometimes within two or three months.

Normally, the casing is surrounded by a protective coating to insulate it against attacks from soil fluids. Nevertheless, imperfections in the protective coating sometimes permit pinholes to be formed in the casing wall, due to corrosion from soil fluids. Thus, moisture may, on occasion enter the casing from outside the casing wall as well as from a leak in the steam conducting pipe.

If a section of a heating system has flooded at the time when the system is turned on in the fall of the year, or if it becomes flooded early during a heating season, a serious situation occurs. The only choices are to shut down the heating system while the flooded section is drained, dried, and repaired, or to allow the flooded condition to exist throughout the entire heating season. If the flooded condition is allowed to exist, the casing in the flooded section may very well be destroyed. It will be understood that it is virtually impossible to repair the leaking or flooded section without shutting down the heating system, because the manholes at the ends of the flooded section become filled with steam, making it impossible to approach the section for remedial and repair action.

The present invention provides a conduit system in which the life of a pipe-surrounding casing is extended by inhibiting water or moisture from entering the casing from sources external thereto, and by preventing any water that does collect within the casing from causing the casing to corrode. Briefly, this is accomplished by supplying gas under a pressure greater than atmospheric within the outer casing of the conduit system, thereby inhibiting the entrance of moisture or water from sources external to the casing, and by locating within the outer casing a sacrificial anode of a more active metal than the casing.

Most advantageously, the anode will be located within the casing, adjacent to but spaced from a lowest portion of the casing when the casing is oriented in the position in which it is used, so that the anode lies within any water that collects in the casing. This is accomplished by a novel arrangement of a conduit system in which sacrificial anodes are properly positioned and maintained conveniently and effectively within the outer casing of the system and in which gas under pressure is supplied in a controlled manner within the outer casing, thereby greatly improving the life of such conduit systems. In addition, sacrificial anodes are provided outside the casing to deter corrosion originating at the outer surface.

This invention makes it possible to continue to use a heating system, even though leaking until the end of the heating season or until a convenient time when the system may be shut down, without casing failure of the protective casing. Furthermore, the gas pressure within the casing aids in locating any leaks in the casing wall, both before and after installation.

Other attendant advantages and embodiments of this invention will be readily appreciated as the same become better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which:

FIGURE 1 is an elevation view, partly in section, showing a corrosion protected conduit system of the present invention in the position in which it is intended to be utilized:

FIGURE 2 is a diagrammatic, partial, view of the conduit system of this invention showing one arrangement for supplying gas under pressure within the casing of the conduit system;

FIGURE 3 is a partial, diagrammatic, view of another embodiment of the conduit system showing an alternative source of pressure for the system.

Referring now to FIGURE 1, there is shown a prefabricated conduit section 9 of a system utilizing the present invention. The conduit sections are positioned in a generally horizontal plane, but may slope downwardly in both directions from an anchor position 16, between the two ends of the section. A suitable anchor is shown in McLeish Patent Re. 22,988. Each end of the conduit section 9 is generally located in a manhole (not shown).

Each conduit section 9 includes an inner pipe 10 for carrying fluid, such as hot water or steam under pressure. Covering the pipe 10 is a layer of insulation 12, which may be fiberglass, asbestos, or other suitable material. Coaxial with the pipe 10 and spaced from the insulation 12 is a tubular casing 14, generally constructed of galvanized steel. A suitable protective coating, such as an asphalt felt material 15, covers the tubular casing 14. A plurality of annular pipe supports 16 of suitable rigid material, such as concrete encased in concentric steel rings 18 and 19, encircle the pipe 10 and maintain the pipe 10 and the casing 14 in spaced, coaxial relationship.

The inner steel ring 18 conforms to the shape and size of pipe 10, while the outer steel ring 19 is corrugated or fluted to provide an irregular periphery, thereby providing passageways within the steel casing 14 from one side of each pipe support to the other. The pipe supports 16 may be of the type disclosed in U.S. Patent No. 2,903,017, issued Sept. 8, 1959 to Val Cotman, Jr., entitled Pipe Support.

As shown in FIGURE 1, a pipe support 16 is located adjacent, but spaced from, each end of the casing 14. Each end of the casing 14 is closed by an annular end
Each pipe support 16 adjacent an end plate 22 or 23 includes an aperture 28 in axial alignment with the respective aperture 24 or 25 of the associated end plate. Electrode rod 40 extend inwardly through the apertures 24, 25 of the end plate 22, 23 and also through the apertures 28 in the adjacent pipe supports 16. The electrodes 40 are constructed of a suitable metal more active (i.e., higher in the electromotive force series of the elements) than the steel of the casing 14. Thus, in the presence of an electrolyte such as water containing impurities within the casing 14, the electrodes 40 will function as sacrificial anodes with respect to the metal of the casing. It has been found that aluminum is a particularly suitable metal for electrodes 40. To provide an electrically conductive contact between the electrodes 40 and the casing 14, a wire 42 from the external end of each electrode 40 is connected to an electrical tap 34, 35 on the casing wall adjacent each end of the casing.

One of end plates 22 and 23 is provided with a threaded opening 45 adjacent an upper portion near the top of the casing, so that the casing is horizontally disposed in use. The threaded opening 45 is adapted to receive a tube or pipe 50 for introducing gas under a pressure greater than ambient pressure to the interior of the casing 14. As shown in FIGURE 2, the tube 50 in threaded engagement with the opening 45 of the steel casing 14 is connected to a gas supply pipe 52 by a pipe coupling 53. The supply pipe 52 is connected to a suitable source of gas under pressure. For example, as shown in FIGURE 2, supply pipe 52 is connected to a cylinder 55 of nitrogen. Suitable control valves are provided along supply pipe 52. These include a relief valve 54, a pressure switch 55, a solenoid actuated valve 56 and a check valve 57. Relief valve 54 relieves the pressure within casing 14 in the event the system becomes flooded and steam is generated. Pressure switch 55 includes two spaced electrical contacts that are set at the maximum and minimum pressure levels desired. These contacts control solenoid actuated valve 56 to permit gas under pressure from cylinder 55 to be introduced into the casing 14. The check valve 57 prevents pressure from being drained from the casing 14 in the event the pressure in the cylinder 55 drops below the minimum pressure desired in the casing 14. The cylinder 55 conventionally includes a pressure gauge 58 indicating the pressure introduced to the supply pipe 52, and a pressure gauge 59 indicating the pressure within the cylinder 55.

The embodiment shown in FIGURE 3 is identical to that of FIGURE 2 except that a supply pipe 52 is connected with an air compressor 60, which is more desirable for relatively large systems. External to the casing 14 and protective covering 15 is a sacrificial anode 65 adjacent each end and, with long sections of pipe, intermediate the ends as well. The anodes 65 are of the same material and construction as the anodes 40. They are fastened, as by a band of asphalt felt protective coating or tape 66, to the casing 14 on top of the covering 15 and electrically connected by a wire 67 to the tap 34 or 35. Thus, a pre-packaged unit that includes internal and external anodes is provided.

In operation, each conduit section casing may be pressure tested for leaks prior to installation. Each pipe and casing assembly forming a part of a conduit system are buried beneath the surface of the ground in a generally horizontal path, with the electrodes 40 adjacent the lowest portion of the casing. Gas under pressure is introduced through the opening 45 into the steel casing 14 of the conduit system, and the pipe 10 is connected into the system and carries steam, hot water, or other fluid under pressure. Normally, with the system beneath the ground, each end of casing 14 will extend into a vertical manhole.

In the event of a small leak in the steel casing 14, gas, such a nitrogen or air, supplied under a pressure of about 9 to 10 pounds per square inch gauge introduced into the casing through the opening 45, will escape through the small opening forming the leak. In this manner, entrance of moisture or water from outside the casing 14 to the interior thereof is prevented. Moreover, the leakage of gas indicates the presence and location of leaks.

In the event water or moisture collects within casing 14, for example, due to a leak in pipe 10, the water will first collect at the bottom of the casing 14 where electrodes 40 are located. Because the electrodes are closely spaced from the bottom of the casing, a very small quantity of water within the casing will contact the electrodes and constitute an electrolyte between the two dissimilar metals, i.e., the zinc coating or steel of casing 14 and the aluminum of electrode 40. As a result, the aluminum electrode, being anodic to the metal of casing 14, is corroded by galvanic action. The casing is therefore protected for as long as the anode lasts. This not only affords ample time to locate and repair the leak, but also allows the option of continuing to use the system until the end of the heating season.

In the event of a hole or tear in the protective covering 15 around the casing 14, moisture in the ground would cause corrosion of the casing from the outside in. The aluminum electrodes 65, being anodic to the casing, protect from this type of corrosion in the same manner as the electrodes 40 protect from internal corrosion, the moisture in the ground forming the electrolyte. In either case, the internal pipe must be electrically isolated from the casing or the internal pipe must be isolated from the piping inside the buildings by dielectric couplings or flanges.

It will, of course, be understood that other materials than aluminum may be used as sacrificial anodes. For example, magnesium may be used, although it does not last as long as aluminum, and zinc may be used with non-galvanized casings, or to protect the casing after deterioration of the galvanized coating. However, zinc anodes tend to become coated by surface materials that inhibit its action as a sacrificial anode. While two anodes have been shown in the preferred embodiment, it will be apparent that, particularly for short sections of conduit, one anode would be sufficient. Conversely, for extremely long runs of conduit, anodes may be included within the conduit intermediate the ends to assure adequate protection. These are installed during assembly and are not replaceable.

It should be evident from the above that the invention provides a conduit system that prevents moisture from entering a protective casing and for extending the life of a casing in the event water does enter. Together, the features of this invention extend the life of the conduit casing, offering assurance to a user that the conduits may be used throughout an entire heating season without shutting down the system to prevent casing failure.

While in the foregoing disclosure certain preferred embodiments of the invention has been disclosed, numerous modifications or alterations may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A combined pipe unit and corrosion protection sys-
5. A pipe unit adapted for carrying fluids comprising, in combination, (a) a length of pipe for carrying fluid, (b) a layer of insulating material directly surrounding said pipe, (c) a tubular casing coaxial with and surrounding said pipe and insulating material in spaced relation, (d) an annular end plate encircling said pipe and closing an end of said tubular casing, (e) a member encircling a portion of said pipe within the casing adjacent to the end plate and constructed to in part receive and support a sacrificial anode, (f) an elongated sacrificial anode extending through said end plate and received in part by said member and supported within the interior of the casing extending along and spaced from the tubular casing wall, and (g) an electrical connection between the tubular casing and a portion of said sacrificial anode.

6. A combined pipe unit and corrosion protection system adapted for carrying fluids such as hot water or steam under pressure comprising, in combination, (a) a length of pipe for carrying fluid under pressure, (b) a layer of insulating material directly surrounding said pipe, (c) a tubular casing coaxial with and surrounding said pipe and insulating material and spaced therefrom, (d) a concrete, metal encased, pipe support within the casing, directly surrounding a portion of said pipe and spacing the pipe and insulating material from the surrounding wall of the tubular casing, (e) an annular end plate encircling said pipe and closing an end of said tubular casing, (f) a sacrificial anode extending through said end plate within the interior of the tubular casing external to the layer of insulating material, and also extending through said pipe support, and located along and adjacent a lowest portion of the casing when the casing is oriented for use, said pipe support serving to maintain the anode within the casing physically and electrically spaced from the casing in the absence of water within the casing, (g) means providing a fluid seal between the anode and the end plate and preventing direct contact between the anode and the casing, (h) an electrical connection between the tubular casing and the sacrificial anode outside of the casing, and (i) means, including a gas conduit and pressure regulating means, for introducing gas under pressure to the interior of said tubular casing.

7. A combined pipe unit and corrosion protection system adapted for carrying fluids comprising, in combination, (a) a length of pipe for carrying fluid, (b) a layer of insulating material directly surrounding said pipe, (c) a tubular casing coaxial with and surrounding said pipe and insulating material in spaced relation, (d) a concrete, metal encased, pipe support within the casing, directly surrounding a portion of said pipe and spacing the pipe and insulating material from the surrounding wall of the tubular casing, (e) an annular end plate encircling said pipe and closing an end of said tubular casing, (f) a portion of a sacrificial anode extending through said end plate within the interior of and spaced from the tubular casing and layer of insulating material and also extending through said pipe support, said pipe support serving to maintain the anode within the casing physically and electrically spaced from the casing in the absence of water within the casing, and (g) an electrical connection between the tubular casing and a portion of said sacrificial anode outside of the casing.

8. A pipe unit for carrying fluids comprising, in combination, (a) a fluid carrying pipe, (b) a layer of insulation surrounding said pipe, (c) a tubular casing surrounding said pipe and layer of insulation and spaced therefrom, (d) a pipe support within the casing, surrounding a portion of said pipe and spacing the pipe and insulation layer from the tubular casing, (e) an aperture extending axially through said pipe support external to the layer of insulation and adapted to be located adjacent a lowest portion of the casing when the casing is horizontally disposed, (f) an annular end plate spaced from said pipe support, encircling the pipe and closing an end of the tubular casing, and (g) an aperture through said end plate axially aligned with the aperture in said pipe support, whereby a sacrificial anode may be inserted into the casing surrounding the pipe and electrically connected to the casing so as to prevent deterioration of the casing due to the presence of an electrolytic substance within the casing.

5. The pipe unit of claim 4 further including a second aperture in said end plate adapted to allow the introduction of gas under pressure into the casing.
gas under pressures from the source through the tube to the casing, said means including:

(1) a relief valve to relieve pressure within the system in the event the pressure increases above a predetermined level, as by the generation of steam within the casing,

(2) a pressure switch between the relief valve and the source of pressure to control the pressure from the source to the casing within predetermined pressure limits lower than the predetermined level at which the relief valve relieves pressure within the system,

(3) a solenoid valve between the relief valve and the source of gas under pressure to permit gas under pressure to be introduced to the casing when energized, and

(4) a check valve between the relief valve and the source of gas under pressure constructed to prevent a flow of gas through the tube from the casing to the source of gas under pressure to prevent pressure loss from the casing in the event the pressure of the source drops below the pressure of the casing.

A pipe unit for carrying fluids comprising, in combination,

(a) a fluid carrying pipe;
(b) a layer of insulation surrounding said pipe;
(c) a tubular casing surrounding said pipe and layer of insulation and spaced therefrom;
(d) a pipe support within the casing, surrounding a portion of said pipe and spacing said pipe and insulation layer from said tubular casing;
(e) an end plate at one end of the casing providing a seal between the fluid carrying pipe and the casing;
(f) a vent opening in the end plate;
(g) a tube coupled to the vent opening;
(h) a source of gas under pressure connected to the tube; and

(i) means associated with the tube to control flow of gas under pressure through said tube between the source of gas and the casing, said means including a relief valve to relieve pressure within the system in the event the pressure increases above a predetermined level, as by the generation of steam within the casing; means between the relief valve and said source of gas under pressure to reduce the pressure from the source to a predetermined level lower than the predetermined level at which the relief valve relieves pressure within the system; and a pressure sensitive switch and check valve between the relief valve and the source of gas under pressure; whereby gas at a predetermined pressure is supplied from the source to the casing, the pressure sensitive switch is actuated in response to a decrease in pressure in the conduit, gas flows from the source to the casing in the event of a decrease in casing pressure below a predetermined pressure level, and flow of gas in a reverse direction from the casing to the source is inhibited in the event the pressure of the source should be less than the pressure within the casing.

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