

Title of Invention: Double Piping Structure equipped with a Leak Detection Device

Background of invention

Field of invention

This invention relates to a double piping structure equipped with a leak detection device.

Description of prior art

This invention relates to a dual piping structure equipped with a leak detection device for piping from buried tanks containing oil or organic solvents such as gasoline.

Today, soil contamination caused by oil (gasoline) leaks and disasters caused by gas leaks have become major social problems. These oil and gas leaks often occur because the piping has become old and corroded due to years of use. For this reason, conventional facilities that handle hazardous materials, such as fueling stations and underground tank storage facilities, use steel piping and coat or paint its outer surface to prevent corrosion.

However, internal inspection of pipes is difficult, and corrosion occurs after years of use, which is an extremely difficult problem, especially for pipes buried underground, coastal pipes affected by salt damage, or long-distance pipes. For example, underground piping can cause soil contamination as mentioned above, and coastal piping (above-ground piping) can cause fires and explosions. Furthermore, it is difficult to locate leaks in long-distance piping.

Summary of Invention

In order to solve the above problem, the present invention provides a dual piping structure in which the piping is double-layered, and a line-shaped detection sensor is installed in the gap between the pipes to detect the occurrence of oil leakage at an early stage and to identify the location of the leakage. Specifically, a primary piping through which at least a liquid of oil other than gasoline or gasoline flows

inside, a secondary piping covered outside the primary piping by maintaining a predetermined gap, a linear arrangement along the gap between the lower bottom surface of the primary piping and the lower top surface of the secondary piping, and the detection of oil leaks from the primary piping by means of a sensor that is installed in a linear arrangement along the gap between the lower bottom surface of the primary piping and the lower top surface of the secondary piping. The dual piping structure can be achieved by providing a dual piping structure with an oil leak detection line that detects leakage of gasoline or oil other than gasoline from the primary piping, and an oil leak reporting device that reports oil leakage from the piping to the outside based on the signal detected by the oil leak detection line.

Brief Description of Drawings

Fig. 1: An example of the application of a leak detection device.

Fig. 2: A diagram of a double piping system.

Fig. 3 (a) is a cross-sectional view of the above piping (B-B line cross-sectional view of Fig. 2), and (b) is an enlarged view of the dotted circled portion A in (a) of the same figure.

Fig. 4 This figure shows the structure of the piping that takes the detection sensor out to the outside.

Fig. 5: An example of the application of the leak detection device of the other embodiment of the invention.

Fig. 6 shows the cross-sectional configuration of an underground tank.

Fig. 7 shows an example of the structure of the inner surface layer at the location where the detection sensor is located.

Fig. 8: An example of the connection method of hollow glass fibers.

Fig. 9: An example of the structure of the inner layer at the end of the hollow glass fiber.

Fig. 10: This figure illustrates an example of the structure of the penetration area where the detection sensor penetrates the inner layer.

Fig. 11: This figure illustrates an example of a connection.

Description of Preferred Embodiment

The following is a description of the embodiment of the present invention with reference to the drawings.

The following description of the embodiments of the invention will be given with reference to the figures. The embodiments described below are only examples, including variations, and the technical scope of the invention is not limited thereto. The technical scope of the invention includes various variations.

Figure 1 illustrates an application example of the leak detection device of one embodiment of the invention. The application example shown in Fig. 1 is for detecting leaks in piping (pipes) for injecting fluid into or suctioning fluid from an underground tank to be buried underground. The fluid is considered a hazardous material. Here, the fluid is assumed to be an oil such as gasoline or an organic solvent such as toluene or methylcyclohexane, and the piping used to detect leaks is assumed to be an oil injection pipe.

Organic solvents are expected to be widely used in hydrogen stations. Due to the toxicity of such organic solvents and the background, it is considered important to ensure that leaks of organic solvents can be detected earlier.

41 in Figure 1 is an inspection port of a buried tank. The oiling pipe 11 is exposed from underground in the inspection port 41, which is located in the upper part of the buried tank from the middle of the pipe. It is difficult to visually detect leaks of gasoline or organic solvents in the part of the oil injection pipe 11 that is buried underground.

Therefore, this example is applied to enable automatic detection of leaks occurring in the part of the oil injection pipe 11 that is buried underground. To this end, the part of the oil injection pipe 11 buried underground is a double piping 30 with a first pipe 31 (first layer), which is connected to the oil injection pipe 11 by welding or other means and used as an oil injection pipe, and a second pipe 32 (second layer) covering the first pipe 31. The connection between the oiling pipe 11 and the double piping 30 is made in the connection box 10. The oil injection pipe 11 is connected to the first pipe 31 via a flange 12. Another flange 42 is

present in the inspection port 41, and between these two flanges 12 and 42 is the double piping 30.

The connection box 10 has other piping 13 into which the lead wires 25 and the detection sensor 15 for detecting leaks are inserted. The detection sensor 15 is a sensor cable whose capacitance is changed by, for example, organic solvents. A sealing 14 is provided to prevent water and other liquids from entering the piping 13. The detection sensor 15 is inserted between the first pipe (primary piping) 31 and the second pipe (secondary piping) 32 of the duplex piping 30, from flange 12 to flange 42. Thereby, the detection sensor 15 changes its capacitance when a leak occurs in any of the first pipes 31.

Figure 2 is a diagram of the above-mentioned duplex piping 30. As shown in the figure, the duplex piping 30 has a resin primary pipe 31 covered by a secondary pipe 32 made of the same resin, and a gap 9 of a predetermined width is formed between the primary pipe 31 and the secondary pipe 32. In this gap 9, the aforementioned detection sensor 15 is installed. The primary piping 31 and secondary piping 32 are not limited to thermoplastic resins such as polyethylene and polyamide, but thermosetting resins such as phenol resin and epoxy resin can be used as materials.

Figure 3(a) is a cross-sectional view of the above piping 30 (B-B line cross-sectional view in Figure 2), and Figure 3(b) is an enlarged view of the dotted circled portion A in the same figure (a). As described above, the double piping 30 has a double structure, with secondary piping 32 covering the primary piping 31. As shown in (a) and (b) of the same figure, the above detection sensor 15 is placed in the gap 9 between the primary piping 31 and secondary piping 32 to detect leakage from the primary piping 31.

This detection sensor 15 is located in a straight line on the underside of the primary piping 31 (on the top of the secondary piping 32). Therefore, even if toluene, for example, flowing in the primary piping 31, leaks out from a defective section formed in the primary piping 31, the leaked toluene flows down along the outer surface of the primary piping 31 and can be reliably detected by the detection sensor 15. The secondary piping 32 serves as a catch basin, preventing leaked toluene or alcohol, for example, from flowing out and contaminating the

soil.

Figure 4 shows the structure of the piping that takes the above detection sensor 15 outside. This duplex piping 30 is basically a duplex piping structure consisting of the aforementioned primary piping 31 and secondary piping 32, but a wiring take-out section 1 is provided to take the detection sensor 15 outside, and through the take-out pipe 2 from the wiring take-out section 1, the detection sensor 15 is taken outside. The detection sensor 15 is taken out of the duplex piping 30 through the take-out pipe 2 from the wiring take-out section 1. The duplex piping 30 (e.g., duplex piping 3) shown in the figure is connected to the aforementioned normal duplex piping 30 (e.g., duplex piping 4) before and after it, and several of these duplex piping 3 and 4 are connected, and the above detection sensor 15 is wired through all duplex piping.

By wiring the detection sensor 15 in a straight line along the underside of the 30 duplex pipes, the detection sensor 15 can reliably detect leaks even when leaks occur from defective sections of the pipes and notify the oil leak detection monitor via cable. Specifically, the detection sensor 15 is connected to the safety retainer 23 via lead wire 25. The leak detector panel 20 is designed to automatically detect leaks occurring in the first pipe 31 and to notify the user when a leak is detected. For this purpose, it is equipped with a leak detector 21 and a buzzer 22.

The leak detection device 21 detects, for example, changes in the capacitance of the detection sensor 15 via the lead wire 25 as changes in voltage values, and identifies whether or not a leak has occurred in the first tube 31 from the detected voltage values. For this purpose, the leak detection device 21 is connected to the DC (Direct Current) terminal 24 to which a DC voltage is applied and is also grounded. The presence or absence of leakage is identified by comparing the detected voltage value with a threshold value determined for each type of organic solvent, for example.

If the leak detection device 21 identifies that a leak is occurring, it emits a buzzer 22 to notify the person in charge. This allows the person in charge to immediately respond to the organic solvent leak. By responding immediately, the damage caused by the leak can be minimized. Thus, in this example, the part of the piping in which the leak should be detected is duplex piping 30, and the detection sensor

15 is placed between the first pipe 31 and the second pipe 32 in the duplex piping 30. Thereby, the detection sensor 15 is used to automatically detect leaks that occur in the first pipe 31.

Therefore, leakage can be detected automatically even if the piping, or part of it, is buried in a location that is difficult to see, for example, underground. In addition, when a leak is detected, the person in charge can immediately recognize it by the sound of the buzzer 22, which makes it easier to minimize the amount of leaked organic solvent. This makes it easier to minimize the amount of leaked organic solvent, thereby minimizing the damage caused by the leaked organic solvent. Even if a hole or crack occurs in the first tube 31, it does not necessarily mean that a hole or crack will also occur in the second tube 32. Even if the second tube 32 is damaged, the amount of organic solvent leaking from the second tube 32 is smaller than the amount of organic solvent leaking from the first tube 31. This also means that the damage caused by the leakage of the organic solvent can be suppressed.

The type of detection sensor 15 that detects leakage is not limited. The reason why a sensor cable is used for the detection sensor 15 is that it can be easily adapted even if the length of the duplex piping 30 is long. The type of detection sensor 15 may be changed according to the length or area where leakage should be detected. The outer second tube 32 may be a component that is attached after the first tube 31 is connected by welding or other means, as long as it can cover the entire first tube 31.

Figure 5 illustrates an application example of the leak detection method according to another embodiment of the invention.

The application example shown in Figure 5 is for detecting leakage of an organic solvent stored in an underground tank to be buried underground. In Figure 5, the same or basically identical items as in Figure 1 are marked with the same symbol. In this example, the leak detector panel 20 is connected to the connection hole 41 by a pipe 61, and lead wire 25 is passed through the pipe 61. The underground tank 50 has a multi-layer inner surface layer 52 (first layer) on the inner surface of a steel plate 51 (second layer).

Detection sensors (sensor cables) 15 are arranged between the inner surface

layer 52 and the steel plate 51. The detection sensor 15 is located between points A and B in Figure 5. Therefore, the inner surface layer 52 should be formed at least between points A and B. The detection sensor 15 and the lead wire 25 are connected at the connection 45.

Figure 6 shows a D-D' section of the underground tank 1 shown in Figure 5. As shown in the figure, the underground tank 1 consists of an inner layer 52 and a steel plate 51, and hollow glass fibers are placed in the gap between the inner layer 52 and the steel plate 51. The hollow glass fibers are arranged to avoid the wiring of conductors, which will be described later.

Figure 7 illustrates an example of the structure of the inner surface layer at the location where the detection sensor is located. This example of the structure of the inner surface layer 52 is an example, and as long as no defects occur, the organic solvent stored in the underground tank 50 should not leak. As shown in Figure 7, in this example, 501 hollow glass fibers are attached to the inner surface of steel plate 51. The detection sensor 15 is placed in the void where the hollow glass fiber 501 is not present. A portion of the detection sensor 15 is inserted and protected within the split tube 510.

The split tube 510 into which the detector sensor 15 is inserted is higher (thicker) than the hollow glass fiber 501. Therefore, oil-resistant double-sided tape 502 is attached to the hollow glass fiber 501 in the form adjacent to the split tube 510, and adhesive coated PET film 504 is attached to the two double-sided tapes 502. Putty 503 is applied to the opposite side of the double-sided tape 502 facing the split tube 510. The outside of the inner layer 52, i.e., the side in contact with the organic solvent, is entirely covered with FRP (fiber-reinforced plastic) 505, for example, a UV-curable type of FRP. This FRP 505 corresponds to the inner surface layer 52 in the narrow sense.

Figure 8 illustrates an example of how to connect hollow glass fibers. Figure 9 illustrates an example of the structure of the inner surface layer at the end of the hollow glass fibers. As shown in Figure 8, the connection of two hollow glass fibers 501 is made by attaching a PET film 504 to them. Putty 503 is applied to the end of the hollow glass fiber 501, as shown in Figure 9.

Figure 10 illustrates an example of the structure of the penetration area where the detection sensor penetrates the inner surface layer. As shown in Figure 10, in this penetration, the split tube 510 into which the detection sensor 15 is inserted penetrates the FRP 505. the FRP 505 is actually formed (e.g., pasted) after the detection sensor 15, including the split tube 510, is placed. To stabilize the detection sensor 15 including the split tube 510, putty 503 is applied; the FRP 505 and the split tube 510, or the detection sensor 15 and the split tube 510, and the detection sensor 15 and the split tube 510 are each sealed by an unshown sealing material. In that way, no leakage occurs in the inner layer 52 unless holes or cracks occur in the FRP 505.

Figure 11 illustrates an example of a connection. The connection 45 is connected to a plurality of pipes 71-73. Each end of the detection sensor 15 is connected to a connector 74. Each connector 74 is connected to a lead wire 25; one of the two connectors 74 is a switching connector 74, to which a communication line 75 is connected in addition to the lead wire 25.

In this example, as in the double piping 30, the leak detection system 21 of the leak detector panel 20 can automatically detect leaks occurring in the inner layer 52 of the underground tank 50. The occurrence of leakage in the inner layer 52 can be presumed to be caused by physical forces acting on the steel plate 51 or by deterioration of the steel plate 51 due to rust or other factors. Therefore, the occurrence of leakage in the inner layer 52 can be considered to indicate that leakage from the steel plate 51 has occurred or is likely to occur.

This example allows such leaks to be addressed earlier and more reliably. The inner layer 52 functions to ensure that the amount of organic solvent leaking from the underground tank 50 is smaller, even if the steel plate 51 is damaged and organic solvent is leaking from the steel plate 51. In this example, it is assumed that the occurrence of leakage in the already existing underground tank 50 is detected, but the underground tank 50 may be buried in the future. In that case, the detection sensor 15 may be placed between the steel plate 51 and the outer surface layer formed on the outside of the steel plate 51.

Description of the code

1 Wirinake-out section,
2 Take-out pipe,
3 Piping,
4 Piping,
7 Gap
9 Gap
10 Connection box.
11 Lubrication pipe,
15 Detection sensor
20 Leak detector panel,
21 Leak detector,
22 Buzzer
25 Lead wire,
30 Double piping,
31 First pipe,
32 Second pipe,
50 Underground tank,
51 Steel plate,
52 Inner layer,
505 FRP.

We claim:.

[Claim 1]

A pipe buried underground,

A first layer and a second layer are formed from the inside of the structure in which the fluid is stored or flowed to prevent leakage of said fluid,

A detection sensor for detecting said fluid is placed between said first layer and said second layer,

A leak detection device for detecting said fluid leaking from said first layer by said detection sensor.

[Claim 2]

A tank buried underground,

A first layer and a second layer are formed from the inside of the structure in which the fluid is stored or flowed, so that said fluid does not leak,

A detection sensor is placed between said first layer and said second layer to detect said fluid,

A leak detection device for detecting said fluid leaking from said first layer by said detection sensor.

[Claim 3]

A leak detection device according to claim 1 or 2, wherein said fluid is an organic solvent.

[Claim 4]

A leak detection device as claimed in claim 1 or 2, wherein said structure is a double pipe with said first layer and said second layer.

[Claim 5]

A leak detection device as claimed in claim 1 or 2, wherein the structure is an underground tank with a first layer and a second layer buried underground.