A barrier for preventing the migration of a hazardous agent, such as gas, etc., along a conduit in a filled-in trench, including a shield with a collar and flaps which slips over the conduit. After the shield is in place the flaps are fastened together, resulting in a gas-tight barrier. The shield is wedge-shaped in two dimensions, width and thickness, so that it forms a tight seal with the sides of the conduit trench into which it is driven. A generally vertical tube mounted on the shield provides access for a gas sensor for sensing the presence of migrating gas adjacent the conduit. The shield has external grooves or internal passages for upwardly venting the sideways migrating gas. The shield is installed with the aid of a tool which is inserted in pockets on the bottom edge of the shield, enabling the shield to be easily driven into the pipe trench and around the conduit. The shield may also incorporate a device for detecting and indicating longitudinal movement of the pipe if it is accidentally pulled out of place.

15 Claims, 15 Drawing Figures
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GAS MIGRATION SHIELD

BACKGROUND OF THE INVENTION

The invention is a shield for preventing the migration of hazardous agents along a conduit in a covered trench. The invention is described in terms of a safety shield for gas service lines, but is not limited thereto.

A particular problem in the use of natural gas and the like as a source of energy is its explosive nature. Gas supply lines which bring the gas to its place of use are buried in trenches and as a result any gas seepage or leakage tends to migrate toward the place of use along the gas service line and trench. This occurs because the looser earth which is used to fill in the trench containing the gas line presents less resistance to this migration. This, of course, on occasion results in a collection of gas within the place of use with the probability that the collected gas may be accidentally ignited. Such ignition usually results in destruction of the dwelling and possible loss of life of persons in close proximity.

There are a number of prior art patents that are directed to the general problem of gas seepage along service lines. One such patent is U.S. Pat. No. 2,871,113 which exemplifies an entrapment technique that utilizes a domed hood-like shield. In the entrapment technique a large hollow gas-trapping space is formed around the service line and vents lighter than air gas to the surface through a tube which projects above the surface. Installation of the apparatus shown in U.S. Pat. No. 2,871,113 is relatively difficult and the apparatus is relative cumbersome and not in general use. Other U.S. patents disclosing entrapment techniques are: Nos. 362,523; 2,160,748; 733,712; 489,392; 2,108,840; 2,134,050; 3,721,536; 2,584,439; 2,473,150; 2,438,619; 3,436,197; 2,727,811; and 2,216,686.

In the present invention the emphasis is on providing a positive barrier to the gas, rather than entrapping only lighter than air gases below ground at or near the pipe and venting above the surface through a tube, thus resulting in a much simpler device with simpler installation and greater effectiveness.

SUMMARY OF THE INVENTION

The invention comprises a barrier against migrating gas, a tool for installing the barrier, and various optional features that can be incorporated into the barrier. The barrier per se comprises a flat shield with a hole therein, near the bottom, for receiving a gas service pipe, conduit, cable, duct, etc. The bottom of the shield is slit so that it can be readily slipped around the pipe. At least one collar is fastened to the shield and around the hole to seal the pipe. The collar is also slit so that it can be slipped around the pipe. The shield and collar slits are then either fastened, chemically welded, or heat fused together, forming a gas-tight vertical shield positioned on the pipe. The shield is wedge shaped for ease in driving it into the sides of the trench carrying the pipe and for getting a good seal between the shield and the sides of the trench. It also extends below the pipe to undisturbed soil thereby preventing gas migration in voids at the trench bottom.

The shield may be grooved or may contain small internal passages for venting migrating gas that comes up against the shield. Other features of the invention include a gas probe access tube mounted on the shield and a means for indicating longitudinal movement of the pipe, which usually results in a serious gas leak.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a gas migration shield mounted on a gas pipe within a trench, and showing a tool for inserting the shield in the trench in broken lines;

FIG. 2 is a view in vertical section as seen generally from the line 2—2 of FIG. 1 showing a front elevational view of the shield of the present invention;

FIG. 3 is a view in vertical section as seen generally from the line 3—3 of FIG. 1 showing the gas migration shield in rear elevation and the installing tool in broken lines;

FIG. 4 is a fragmentary view in vertical section on an enlarged scale as seen generally from the line 4—4 of FIG. 3;

FIG. 5 is an enlarged view in horizontal section as seen generally from the line 5—5 of FIG. 3;

FIG. 6 is a greatly enlarged fragmentary view in horizontal section illustrating a portion of the shield being mounted on a gas pipe;

FIG. 7 is a greatly enlarged horizontal sectional view illustrating a seal formed by the portions shown in FIG. 6;

FIG. 8 is a view in front elevation of a modified embodiment of the gas migration shield of FIG. 1;

FIG. 9 is a view in front elevation of a still further modified embodiment of the gas migration shield of FIG. 1;

FIG. 10 is a view in horizontal section on an enlarged scale as seen generally from the line 10—10 of FIG. 8;

FIG. 11 is an enlarged view in horizontal section as seen generally from the line 11—11 of FIG. 9;

FIG. 12 is a greatly enlarged vertical section as seen generally from the line 12—12 of FIG. 9;

FIG. 13 is a diagrammatic view of a typical installation of a plurality of gas migration shields in a gas supply system;

FIG. 14 is an enlarged elevational view of a detection system employed on the gas migration shield for indicating movement of a gas pipe relative to the shield; and

FIG. 15 is a view in vertical section as seen generally from the line 15—15 of FIG. 14.

DETAILED DESCRIPTION

FIG. 1 is a side edge view of a migrating gas barrier together with an installation tool 23 for positioning the migrating gas barrier in a trench and on a gas service pipe 14. The barrier includes a shield 10 with a hole 10e near the bottom thereof for receiving the gas pipe 14. A tube 16 is vertically mounted on the face of shield 10 by mounting means, such as two sets of molded fingers 18 and 20. Alternatively, tube 16 may be chemically welded or heat fused directly to the face of shield 10. The bottom end of tube 16, referenced with the numeral 16a, is enlarged. Enlarged end 16a is positioned adjacent to and overlying gas pipe 14. Tube 16 provides access for a probe or sensor, not shown, for detecting the presence of gas migrating externally along pipe 14 through the disturbed earth, also not shown, but which normally fills trench A. A plug or cap 22 inserted in the top end of tube 16 prevents the tube from becoming plugged with dirt, etc. Cap 22 also serves to physically locate pipe 14 and may be numbered or coded to specifically identify pipe 14.
An installation tool 23 is positioned adjacent the back surface of shield 10, and includes a longitudinal shaft 24 and a handle 26 fastened to the top of shaft 24. A lateral extension, or step, 28 is mounted on the middle portion of shaft 24 and provides means for applying a downward force on the installation tool 23. When shield 10 is ready to be driven downward into place, the installer briefly stands on, or steps on to, step 28. The tool also includes outwardly slanting legs 30 and 32, the tops of which are attached to the lower end of shaft 24. The bottom ends of legs 30 and 32 fit into tapered pockets 36 and 37 on the bottom edge of shield 10. Legs 30 and 32 are shown more clearly in FIG. 3 which is a back view of shield 10 from cutting plane 3—3 in FIG. 1. As shown in FIG. 3, a link 33 is connected between legs 30 and 32 to limit their spreading. The bottom ends of legs 30 and 32 terminate in tips 35 and 39 which fit into the pockets 36 and 37.

FIG. 2 is a front view of shield 10 taken from the cutting plane 2—2 in FIG. 1. Shield 10 in FIG. 2 is shown positioned in the trench A. Shield 10 is wedge-shaped in the height dimension and the edges 10a and 10b of the shield 10 are shown extending into the undisturbed earth of the side walls of the trench. This promotes a tight seal between shield 10 and the trench. Briefly referring back to FIG. 1, note that edges 10a, 10b of the shield 10 are also wedge-shaped in the thickness dimension, to further promote a tight seal between shield 10 and undisturbed earth of the walls of the trench A.

A cut 42 is made in shield 10 between the hole 10c in the bottom portion of shield 10 and the bottom, rounded edge of shield 10. Cut 42 is shown as being vertical and divides the bottom portion of shield 10 into two flaps 10c and 10d. Cut 42 is necessary in order to slip shield 10 around pipe 14. After pipe 14 is received within the hold 10c, the flaps 10c and 10d are closed or sealed, providing a gas-tight barrier which prevents horizontal migration of gas along the trench A. As shown in FIG. 3, flaps 10c and 10d may be closed by means of snap buttons 41 and 43 on flap 10c engaged in appropriate openings formed in flap 10d. Also, flaps 10c and 10d may be fastened together with opposing hooked edges, which will be described below in connection with FIG. 7, and which may be chemically welded or heat fused together.

FIG. 4 is a view taken along cutting plane 4—4 in FIG. 3. The hole in shield 10, designated 10e, is shown more clearly in the sectional view of FIG. 4. Round collars 12 and 13 are fastened, e.g., chemically welded or heat fused, to the front and back surfaces of shield 10 around hole 10e. A cut 12a, 13a is made in each collar so that they may be initially slipped around pipe 14. The cut 12a in collar 12 is shown in FIG. 2 and the cut 13a in collar 13 is shown in FIG. 3. After the collars 12 and 13 have been installed around pipe 14 the cuts 12a, 13a in the collars 12, 13 can be fastened, chemically welded, or heat fused together. When the collars 12, 13 have been fastened the outer portions thereof provide a friction fit around pipe 14 which is not destroyed even if pipe 14 experiences some longitudinal movement. A single collar 12 or 13 may provide an adequate seal.

Gas service pipes are often accidentally pulled by digging machines, etc., being used out near the gas mains. A longitudinal motion indicator 70 warns the working crews that a service pipe has been accidentally pulled which usually creates a dangerous gas leak. A housing 71 for the longitudinal motion detector 70 is chemically welded or otherwise fastened to the front face of shield 10. Longitudinal motion of pipe 14 in the direction of the arrow is imparted to the longitudinal motion detector by means of a lead 72, the lower end of which is tied to a projection 74c of clamp 74 secured on pipe 14. Referring to FIG. 14 the upper portion of lead 72 is wrapped around a spool 76 which is rotatably mounted in housing 71. The upper end of lead 72 is fastened to spool 76. Another lead 78 is fastened at one end to spool 76 and wrapped therearound. The other end of lead 78 is extended upward through a vertical tube 80 attached to the top of housing 71 and extending to the top of shield 10. The top of lead 78 terminates in a cap 78a which covers the opening of tube 80, when lead 78 is in its lowered position. If pipe 14 is subjected to longitudinal motion (in a direction toward a viewer in FIG. 14), the motion is imparted to spool 76 by lead 72, causing spool 76 to rotate in a counterclockwise direction, which pushes lead 78 upward, as shown in FIG. 14 by the dashed outline at the top of shield 10. Lead 78 has a highly visible color (e.g., a glowing orange) and can be seen from quite a distance, giving an indication that pipe 14 has moved longitudinally. As shown in FIG. 14, tube 80 is fastened to the face of shield 10 by two sets of fingers 82 and 84. Tube 80 may also be chemically welded or heat fused directly to shield 10.

FIG. 15 is a view from the cutting plane 15—15 in FIG. 14. Lead 72 is wound around the front portion of spool 76 and lead 78 is wound around the rear portion. Spool 76 rotates about an axial shaft 86. The front and rear portions are shown as being about the same diameter, but the diameter of the front may be decreased so that rotation of spool 76 is increased for a given longitudinal movement.

Referring to FIGS. 6 and 7, gas pipe 14 is shown being passed through cut 42 between flaps 10c and 10d. After pipe 14 has been pushed through cut 42, flaps 10c and 10d are joined by means of the buttons 41, 43 on flap 10c which buttons 41, 43 snap into cooperating holes on flap 10d, such as button 41 shown in FIG. 7. In FIG. 7, flaps 10c and 10d are shown snapped closed with flaps 10c and 10d fastened together by hooked edges 10f and 10g and a suitable adhesive 44.

Referring to the modified embodiment of FIG. 8, the front face of shield 10 has a set of vertically extending grooves 54 formed therein. These grooves 54 promote the upward venting of horizontally migrating gas coming up against shield 10.

FIG. 10 is a view taken along cutting plane 10—10 in FIG. 8 and shows the cross-sectional shape of grooves 54. As shown, grooves 54 are dovetail in section to discourage the entry of dirt into the grooves 54. However, other cross-sectional shapes may serve equally well.

Another embodiment is shown in FIG. 9 in which shield 10 has a set of vertically extending internal passageways 56. Each passageway 56 has a set of side inlet openings 56a and a bottom inlet opening 56b for the entry of migrating gas into the passageway 56. FIG. 12 is a view along cutting plane 12—12 in FIG. 9 clearly showing a passageway 56 and inlet openings 56a and 56b.

FIG. 11 is a view taken along cutting plane 11—11 in FIG. 9, showing the internal passageways 56 in shield 10 as being cross-sectionally circular. However, once
again, other cross-sectional shapes may serve equally well.

A typical installation is shown in Fig. 13. Gas from main line 15 is delivered to the homes through service pipes 14. Each service pipe 14 is provided with a shield 10 between the home being serviced and the junction of service pipe 14 with main line 15. In addition, the junctions made by the service pipes 14 with the main lines 15 are bracketed by or contained within a pair of shields 10. Therefore, gas cannot migrate along main line 15, nor, if there is a leak between the shields on main line 15, can gas migrate along the service pipes 14 to the homes.

What is claimed is:

1. A barrier for preventing the migration of gas along the exterior of a pipe positioned in a trench, said barrier comprising:
   a. a gas impervious shield extending from the bottom to the top of the trench and between the side walls thereof;
   b. said shield having a hole formed therein for receiving the pipe;
   c. said shield having a cut formed therein extending from said hole to an outer edge of said shield to permit the entry of the pipe into said hole;
   d. flap means for sealing said cut after the pipe is positioned in said hole;
   e. a collar secured to said shield around said hole, said collar having a cut formed therein extending through one side thereof to enable said collar to be initially engaged around the pipe so as to provide a seal between the pipe and said shield; and
   f. seal means for securing said flap means and for joining said cut in said collar whereby a gas-tight shield is formed completely around the pipe.

2. The structure of claim 1 wherein said flap means comprises a flexible flap portion integrally formed on said shield along opposite sides of said cut and wherein said seal means includes snap buttons formed on one of said flap portions and receivable in cooperating openings formed in the other of said flap portions.

3. The structure of claim 2 wherein said seal means further includes chemical adhesive means for joining said flap portions and for joining adjacent edges of said cut in said collar.

4. The structure of claim 1 wherein said shield is vertically wedge-shaped in width and thickness dimensions.

5. The structure of claim 1 including a tube for inserting a sensor device adjacent the pipe; and means for mounting said tube on said shield, one end of said tube opening over the pipe receiving hole and the other end of said tube opening near the top of said shield.

6. The structure of claim 5 wherein said one end of said tube is enlarged.

7. The structure of claim 1 in which said shield has a lower edge portion formed generally in a semi-circular configuration; and wherein a pocket is formed on one face of said lower end portion on opposite sides of said cut for receiving an installation tool whereby the shield is rigidly supported by the tool for installation around a pipe in a trench.

8. The structure of claim 7 wherein said installation tool comprises:
   a. a longitudinally extended shaft having top and bottom ends;
   b. a handle mounted on said top end of said shaft;
   c. a lateral extension mounted on said shaft between said top and bottom ends, said extension providing a step for the application of downward force by a shield installer;
   d. a pair of spaced legs;
   e. means for mounting one end of said legs to the bottom end of said shaft;
   f. a link connected between said legs to limit their spacing; and
   g. a tip on the other end of each leg for insertion into one of said pockets on said shield whereby said shield is rigidly supported for installation around a pipe in the trench.

9. The structure of claim 1 wherein vent means is formed in said shield for venting migrating gas upwardly from said pipe.

10. The structure of claim 9 wherein said venting means includes a set of generally vertically extended grooves formed in one face of said shield.

11. The structure of claim 10 wherein said grooves have a dove-tailed cross-sectional configuration.

12. The structure of claim 9 wherein said venting means includes a plurality of generally vertically extended internal passageways formed in said shield, said passageways having bottom and side inlet openings formed therein and an outlet opening formed therein at the top of said shield.

13. The structure of claim 1 including indicator means for indicating longitudinal movement of the pipe relative to said shield.

14. The structure of claim 13 wherein said indicator means includes:
   a. a spool rotatably mounted on said shield;
   b. first cable means having one end attached to said spool and wound thereon and the other end attached to the pipe for imparting rotary movement to the spool when the pipe moves longitudinally from said shield; and
   c. second cable means for indicating that longitudinal movement of the pipe has taken place, having one end attached to said spool and wound thereon in an opposite direction with respect to said first cable means whereby the other end of said second cable means moves upwardly beyond the ground surface in response to rotary movement of said spool.

15. The structure of claim 11, wherein the portion of said flexible member projecting from said spool is encased in a vertically extended tube fastened to said one face of said shield.

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