United States Patent [19]

Horne

[11] **3,880,176**

[45] **Apr. 29, 1975**

[54] **APPARATUS FOR SEWER TREATMENT TO KILL TREE ROOTS AND OTHER ORGANIC GROWTH THEREWITHIN**

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[73] Assignee: **Airrigation Engineering Company, Inc.**, Carmel Valley, Calif.

[22] Filed: **Apr. 30, 1973**

[21] Appl. No.: **355,808**

Related U.S. Application Data

[60] Division of Ser. No. 122,738, March 10, 1971, Pat. No. 3,741,807, which is a continuation-in-part of Ser. No. 850,321, Aug. 6, 1969, abandoned, which is a continuation-in-part of Ser. No. 760,822, Sept. 19, 1968, abandoned.

[52] **U.S. Cl.** ..... **134/167 C**; 118/306

[51] **Int. Cl.** **B08b 3/02**; B08b 9/02

[58] **Field of Search** .... 134/22 C, 24, 166 C, 167 C, 134/168 C, 169 C, 171, 172; 118/DIG. 10, 306

[56] **References Cited**

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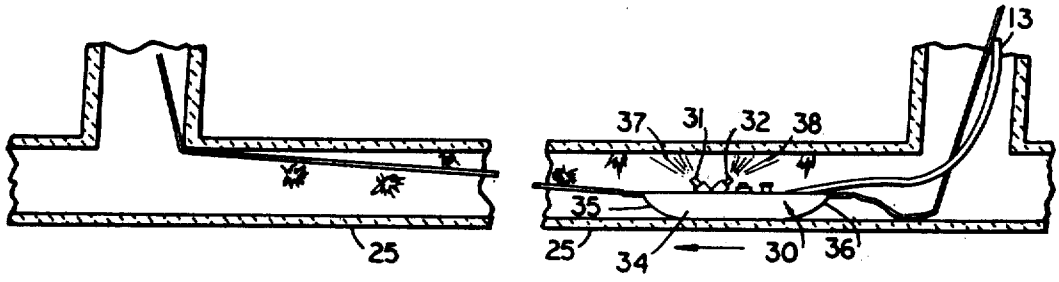
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Primary Examiner—Robert L. Bleutge
Attorney, Agent, or Firm—Owen, Wickersham & Erickson

[57] **ABSTRACT**

A composition for killing plant roots inside sewers, comprises an alkali metal alkyl dithiocarbamate in an amount of about 30%, a biodegradable liquid nonionic surfactant in an amount of about 12%, and water making up the remainder. One method for treating the sewer pipes comprises coating the inside wall of the pipe and any roots or other growth inside the pipe with the composition in the form of a foamy film by spraying it thereon or on the upper portion thereof, as from a continuously moving device. Preferred apparatus for so treating the sewer pipes comprises a sled having bottom skid means, a low center of gravity and a spray system mounted on said sled having generally upwardly directed nozzles, and means for pulling the sled through a pipe while supplying it with the composition under pressure. Another method comprises soaking with the solution diluted to about 2% of the methyldithiocarbamate, this being done by plugging the pipe and filling the pipe above the plug with the diluted solution. Special plugging apparatus is described.

9 Claims, 14 Drawing Figures



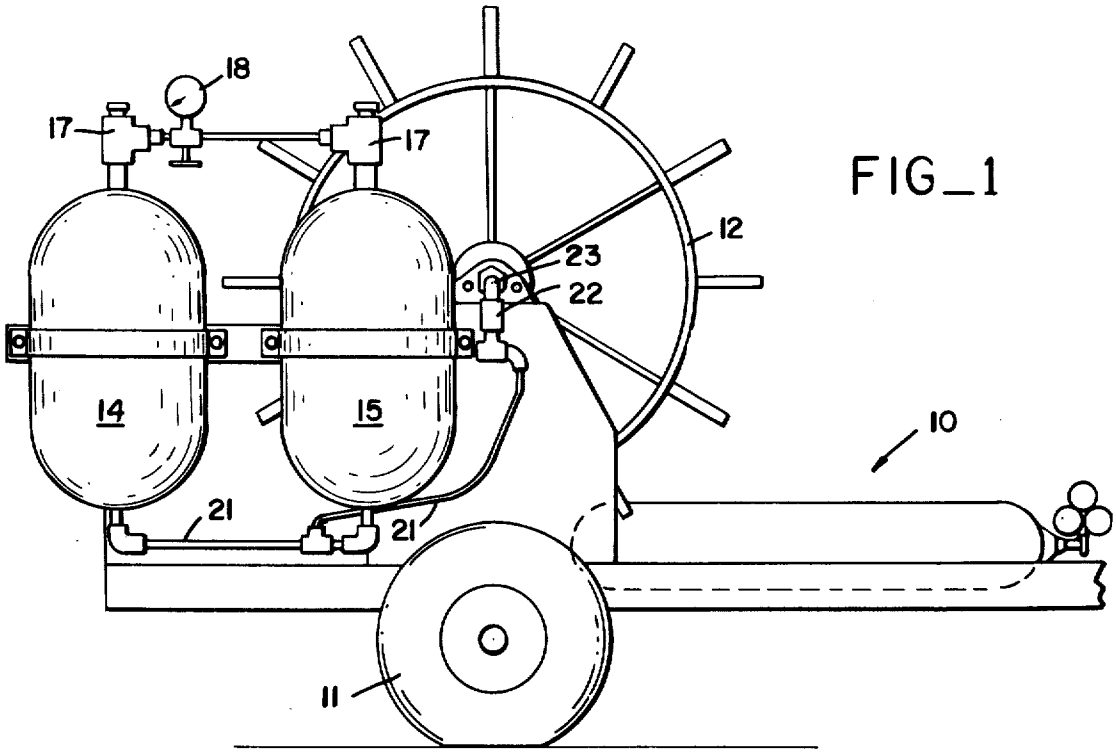

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FIG_1

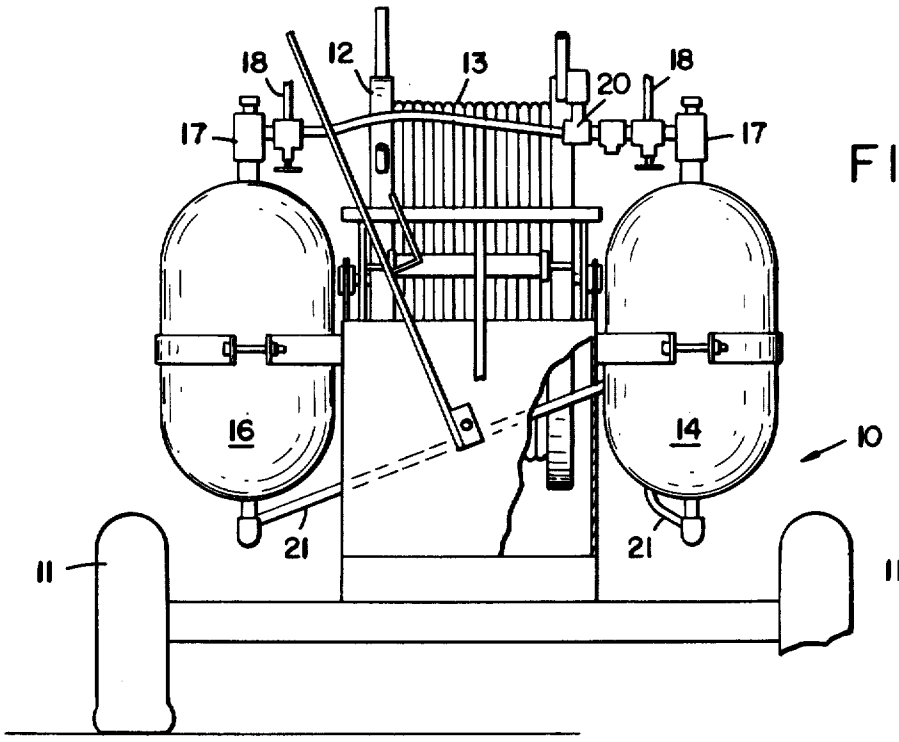

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FIG_2

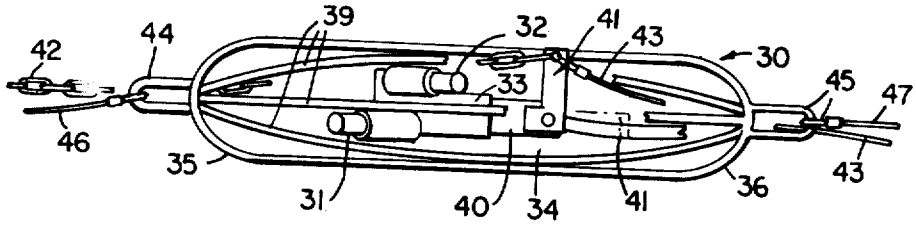


FIG_3

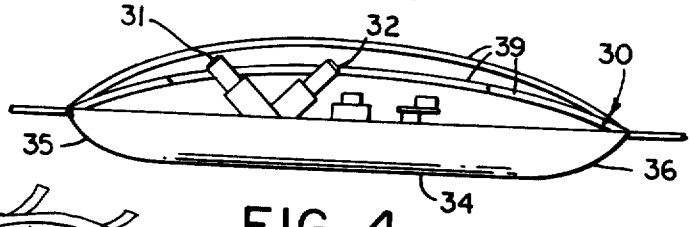


FIG_4

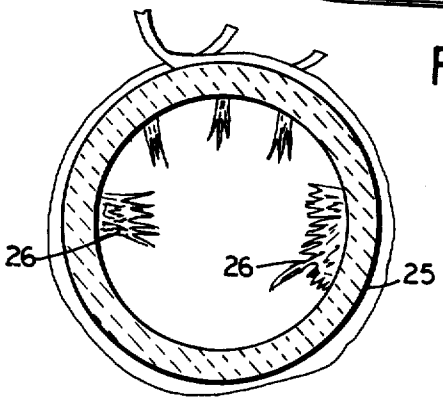


FIG_5

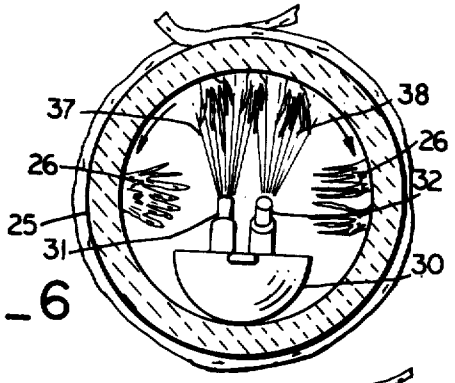


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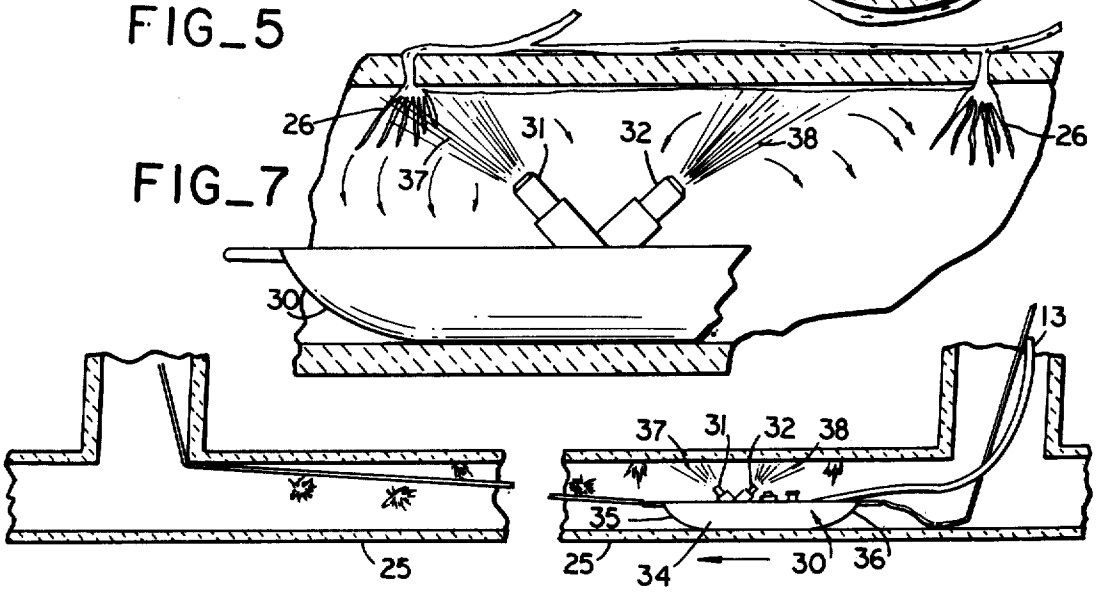


FIG_7

FIG_8

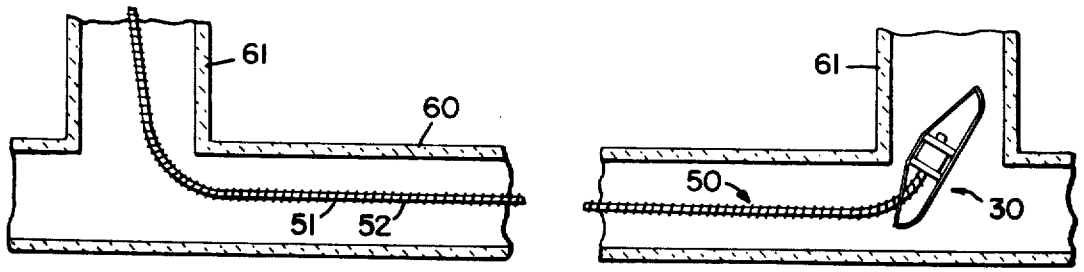


FIG_9

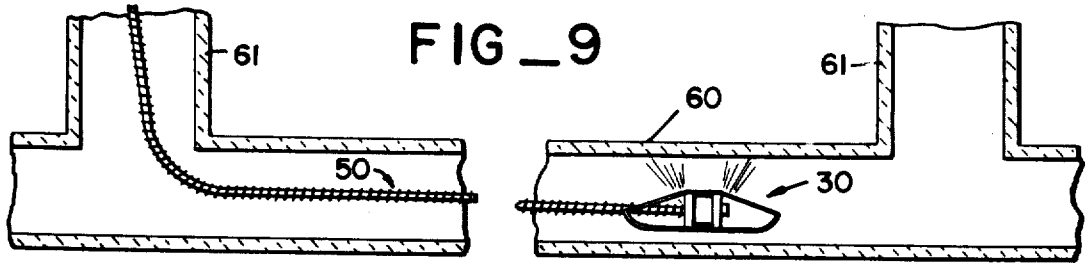


FIG_10

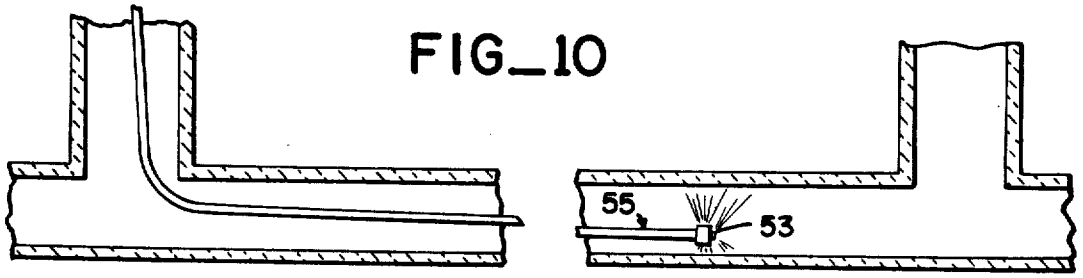


FIG_11

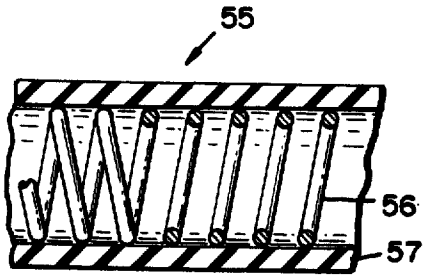


FIG_13

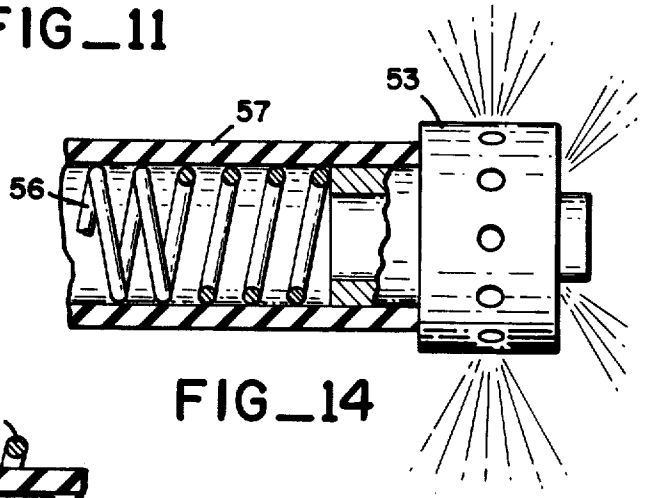


FIG_14

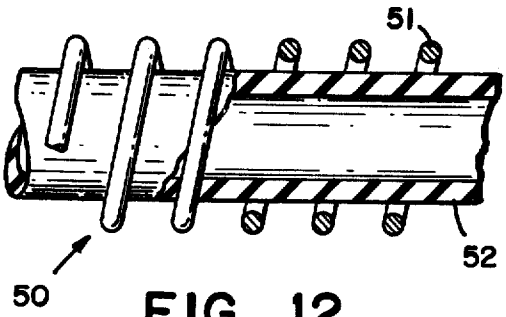


FIG_12

APPARATUS FOR SEWER TREATMENT TO KILL TREE ROOTS AND OTHER ORGANIC GROWTH THEREWITHIN

This is a division of application Ser. No. 122,738 filed Mar. 10, 1971, now U.S. Pat. No. 3,741,807, which was a continuation-in-part of application Ser. No. 850,321 filed Aug. 6, 1969 now abandoned, which was a continuation-in-part of application Ser. No. 760,822 filed Sept. 19, 1968, now abandoned.

This invention relates to the treatment of sewers and other conduits to control plant growth therein. It relates to novel compositions for use in the sewers to kill root growth therein; to novel and effective methods for application of this composition; and to apparatus by which the composition may be applied.

Many materials for controlling plant root growth in sewers and other drainage conduits have been tried, such as copper sulfate, which has been the most widely used chemical for this purpose over many years, but none of them has proven satisfactory in the long run. One of the main problems has been the fact that most tree roots come down from above, and such roots have not been affected by the treatments tried. The reasons for this ineffectiveness have been twofold: (1) the chemicals have been contained in and confined to the sewer water in the lower part of the pipe and therefore do not even touch the roots that lie above the sewer water; (2) such chemicals require a relatively long exposure to the roots to be effective, so that the only roots killed are those which remain for a long enough period in contact with the water containing such chemical agents. To explain further, sanitary sewers are designed to transport waste water at much less than the capacity of their conduits; hence, the waste water is normally in only the lower part of the pipe; thus, the copper sulfate and other herbicides and fungicides carried in the waste water under normal flow could be effective only in that lower part of the pipe where the roots may be in contact with the sewer water, and not elsewhere. However roots entering from above tend to die anyway when they reach the normal water flow line, due to the lack of oxygen in the sewage; these dead roots have practically no absorptive ability, but roots continue to grow above the flow line and to occupy and fill the major area of the pipe, eventually resulting in plugging. The prior art treatment materials may be potentially effective on any tree root which enters the sewer from below, but lack of oxygen generally prevents this from happening; so this limited effectiveness has been insufficient to prevent tree roots from plugging sewers. No composition carried by the sewer waste water has been able to keep the entire pipe free from roots, nor to rid the pipe from all roots. Moreover, no sufficiently effective method of sewer pipe treatment for this purpose has heretofore been found.

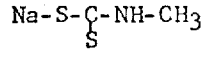
An excellent material for killing tree roots is sodium methyldithiocarbamate, a chemical heretofore used successfully as a soil fumigant and for some other things, but it did not prove to be as effective in sewers as one might expect; the vapors alone proved to be rather ineffectual. It was proposed that a chemical fire-extinguisher foam be used as an extender or carrier, and such chemical foam with the liquid fumigant entrained was injected into sewers; by the expansion pressure exerted, the fire-extinguisher foam was forced along the conduit and as the foam disintegrated, active gaseous fumigant was released. improvement was, indeed, obtained by this expedient, but unfortunately this Improvement required the conduit to be completely filled under expansive foam pressure in order to distribute the active fumigant to the surfaces to be treated, and this required extremely large volumes of both the chemical fire-extinguisher foam and the active agent, as well as pressure to push the foam through the pipe. Thus, that process was too expensive for general use. Moreover, the chemical fire-extinguisher foam itself tended to block the sewage flow, so that the sewer had to be taken out of service for extended periods during this treatment. Further, the charging into the pipes of the fire-extinguisher foam with the entrained active agent was a time-consuming operation, and the labor cost was not economically practical for large diameter or long conduits, especially when that cost was added to the materials cost of the large volume of chemical foam extender needed. Even then, many roots were not killed and remained.

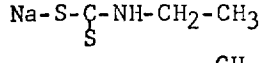
Other investigations showed that, when sodium methyldithiocarbamate was introduced by spraying the pipe interior with a simple water solution, it tended to decompose too quickly from the water present to be Also, effective. Aslo, the water solution of the active chemical readily ran down the pipe walls and quickly became part of the sewage flow, bypassing the roots above it. These investigations led me to believe that organic slime and other soils and greases were tending to protect many tree roots from surface absorption and treatment, so that they were not significantly damaged by what otherwise might be considered intensive treatment. Furthermore, the roots appeared to be protected in many instances by outer cell walls rich in cutin and suberin, which did not significantly imbibe either water or the fumigant solution in water. A closed television circuit which was lowered into sewers enabled the taking of pictures from outside the pipe as well as displaying an image of what was inside the sewer, and these pictures showed that many such roots were not killed even after very intensive treatment by water solutions containing sodium methyldithiocarbamate.

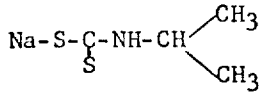
The present invention provides a solution to the problem. All roots within the sewer are killed, no matter from what direction they come and no matter at what level the waste water flows. Moreover, a new and economical use of the composition of this invention, makes it possible to kill these roots without killing or even damaging the same or other roots outside the sewer and without damaging the plants from which the roots come. However, to give longer protection, it is also possible, in instances where the joints of the pipe are damaged or leak to extend the killing action somewhat beyond the pipe interior, thereby delaying the regrowth considerably, still without substantially damaging the plants, because the material used herein is not a systemic plant poison.

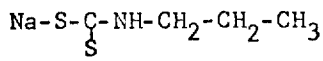
Even more important, my new composition penetrates the cutin and suberin of the root walls, which are impermeable to untreated water, and carries the active material inside the root cells, so that the toxic effect is greatly enhanced. When used as a spray, my invention provides a novel small-bubble foam, which adheres to the roots. When used in a soak, more dilute solutions are quite effective. My new composition acts even on roots and other growths which are covered with slimes and greases, and it also cleans the roots and the pipe while killing these biological growths and the roots.

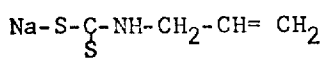
The chemical composition of this invention is a combination of standard alkali metal alkyl dithiocarbamade in its usual inert ingredients (e.g., water), with a biodegradable nonionic surfactant. This combination accomplishes what neither ingredient can do alone: neither the surfactant nor the dithiocarbamate, when used alone, kills a significant amount of sewer roots. However, the combination kills all or substantially all the sewer roots, when properly applied. Typical alkali metal alkyl dithiocarbamates usable in this invention and their formulas are:

sodium N-methyl dithiocarbamate 

sodium N-ethyl dithiocarbamate 

sodium N-isopropyl dithiocarbamate 

sodium N-propyl dithiocarbamate 

sodium N-allyl dithiocarbamate 

In each of the above, potassium may be substituted for sodium. So may other alkali metals, but the sodium and potassium compounds are the cheapest, the most soluble, and probably the best. The first compound named above, also called simply sodium methyl dithiocarbamate is the most volatile and is usually preferred.

A preferable class of surfactants usable in this invention is the alkyl aryl polyether alcohols and the ethers thereof. For example, an octylphenoxyethanol, such as a water-soluble iso-octyl phenoxy ethanol containing 10 moles of ethylene oxide (Triton X-100) has been proved very effective. Another alkylaryl polyether alcohol is Retzanol NP100, of Retzloff Chemical Co, a nonyl phenoxy polyoxyethylene ethanol, a clear liquid with a pour point below 0°C, a specific gravity of 1.06 at 25°C, soluble in water. Another is Tergitol NPX (Union Carbide)a nonyl phenyl polyethylene glycol ether.

By adding the surfactant in amounts of about 12½% (one eighth) of the volume of the regular fumigant mixture (a water solution having an active ingredient rating of about 36%, meaning a 36% aqueous solution of for example, sodium methyldithiocarbamate), a preferred concentrate formulation is obtained wherein the active ingredient, the sodium methyldithiocarbamate, is about 28 to 30% of the whole. In other words, my new composition may be distributed to buyers as a concentrate consisting of a water-soluble foam-type surface-active formulation, having about 30% of alkali methyldithiocarbamate, about 12% of the surfactant, and about 58% water. In more approximate figures, this concentrate is an aqueous solution of about three-tenths fumigant and one-eighth surfactant. There is about twice or thrice as much of the methyldithiocarbamate as of the surfactant, water making up the remainder. Other alkali metal alkyl dithiocarbamates are used in the same amounts.

Use may be by spray or by soaking, and for actual use, more water is added to the concentrate.

For spray application the concentrate is preferably diluted by three parts of water to one part of concentrate. The diluted spray material is thus about one-twelfth sodium methyldithiocarbamate and about one-thirtieth surfactant, and about nine-tenths water. This composition, when sprayed on or toward the sewer walls forms a foamy film that kills or materially inhibits the growth of all plant roots and other organic growth in the interior of the sewer. The surfactant in the spray composition does several things: (1) The surfactant acts to maintain the active fumigant for a sufficient time in an active foam state on the pipe and root surfaces; (2) it provides the foam, which adheres well to all surfaces instead of running down and dripping off ineffectually, as would a water spray; (3) the surfactant removes the coatings of slimes, greases, soaps, and dirt that cover and protect the roots; and, (4) it holds the fumigant on and near the cleaned roots and surfaces, where the fumigant can be most effective. As a result, only about one-sixth or one-seventh or even less of the alkali methyldithiocarbamate is used as when fire-extinguisher foam is used to fill the pipe, while the results are far, far more effective. Only the surfaces need be coated with the foamed fumigant spray solution, and in this invention that can be done quite efficiently.

In another treatment according to this invention, the fumigant-surfactant concentrate is further diluted, down to about one or two percent fumigant concentration, and then a length of the sewer pipe is filled and soaked. Here, again, the effectiveness is quite different from filling a sewer pipe with a water dilution of the fumigant alone at the same fumigant concentration. The surfactant acts to clean and expose the roots while the fumigant simultaneously attacks them. Penetration is assured by having both the surfactant and fumigant simultaneously present. The biological slimes, fatty acid soaps and greases, etc., are effectively emulsified and dispersed into the waste water flow, and the root cells are destroyed, causing the roots to decompose and slough off. By employing a pair of plugs and working with gravity from an upper level down, the same solution can be used in several successive soaking operations, thereby economizing in material, and for this purpose novel plugging apparatus and systems have been developed.

Especially in the soak-treatment, but also in the spray treatment, growth inhibitors may be incorporated to cause greater root die-back and to prolong the time during which no re-treatment is required. For this purpose, the only limitations on the use of any particular growth inhibitor (growth inhibitors being a well-known group of herbicides) are that it not be systemic, so as to poison the entire plant and kill it (though they may even be systemic to a degree, i.e., to kill roots back a few inches or so) and that there be no chemical reaction between the growth inhibitor and the fumigant or surfactant so as to nullify any of the ingredients. For example, 4-(methylsulphonyl)-2,6-dinitro-NN-dipropylaniline, trifluralin (an approved common name

for 2,6-dinitro-NN-dipropyl-4-trifluoromethylaniline), dichlobenil (an approved common name for 2,6 dichlorobenzonitrile), and S-(O,O-diisopropyl phosphorodithioate) of N — (2 mercaptomethyl) benzenesulfonamide) have all been tried and have been found to give very satisfactory results, with root killbacks a few inches beyond the pipe walls. Also, where a pipe has breaks or its joints are broken or leak, the soak treatment sets up hydraulic pressure and, in conjunction with the growth inhibitor, extends the treatment beyond the interior of the pipe and considerably inhibits or delays regrowth, yet without significant damage to the plants themselves.

In some instances, it may be desirable to add a further treatment simultaneously to rid the sewer of insects, such as spiders, roaches, and sewer flies. Some of them may be killed by the fumigant, but other chemicals may be added to the solution to obtain a residual control, so long as they do not react with the other ingredients in a way that diminishes the activity and efficiency of any of the treating materials. Chlordane, DDT, diazinone, roach wettable powders and so on, may be added in effective amounts, as may some specific fungicides, if desired, so long as the added chemicals do not detrimentally react with the fumigant or surfactant (a growth inhibitor, if present) in the original solution.

My new composition is nonsystemic, so that it does not harm the plants themselves, but it does control all the roots which are in sewer mains or other conduits so treated, and it also helps to control any fungi, or bacteria such as produce slimes, and fatty acids. In this way, the generation of hydrogen sulfide in the sewers is reduced, and the roots and organic deposits are handled so effectively by my new composition that substantially no harmful residue remains. The gaseous fumigant itself is dissipated within a few hours, and the composition as a whole is readily biodegradable. Moreover, the biological slimes, fatty acids, etc., are effectively emulsified and dispersed into the waste water flow, and the root cells that are destroyed result in the decomposition and sloughing off of the roots, which are thus carried down the sewer.

To illustrate the biological effectiveness of the invention, a sample of the solution, diluted to (20.4% active sodium methyldithiocarbamate) was bioassayed in comparison to the standard solution (32.7% active material). The procedure followed was to dilute each solution with three parts water and then place 0.1 ml of the diluted solution into vials containing 9.9 ml of sterile Difco bacto-malt broth or bacto-nutrient broth. The broth was then inoculated with spore suspensions of *Aspergillus niger*, *Penicillium italicum*, *Escherichia coli*, and *Staphylococcus aureus*. The vials were sealed and, after one week, observations were made on the growth of the organisms in the vial. All vials inoculated with both formulations remained clear and no growth of the organisms occurred. The growth of the fungi and bacteria in untreated vials was heavy.

As stated earlier one method of application includes spraying my new composition, with the concentrate diluted by about three parts of water to one of the composition. The spray impinges a small bubble foam upon the surfaces inside the pipe by directing the spray upwardly while moving the spray apparatus, preferably at a substantially constant rate through the pipe and while maintaining the spray nozzles in a proper orientation, so that the spray is directed upon the upper portion of the pipe and roots and slimes and other growth, above the normal level of the waste water flow. Much of the foam adheres where it impinges, while some of the material runs down the pipe walls into the waste water and is also effective there. The small bubble foam slowly releases the active fumigant and fills the pipe with the toxic vapor, so that the whole inside volume is treated effectively with the fumigant.

The spraying apparatus of the invention may include a set of pressure tanks for the solution of this invention interconnected with an inlet manifold and suitable valves which control a gas supply and terminate in the side opening of a tee connection. The tanks may be interconnected through a discharge manifold to a reel-mounted pressure hose through an appropriate swivel fitting. A sled-mounted spray assembly of a size able to pass through the sewer is equipped with a pair of atomizer nozzles with orifices, one leading forward, the other to the rear, which apply the solution at a suitable rate, such as a quarter of a gallon of diluted solution per minute at a pressure of a hundred pounds per square inch. The sled-mounted spray assembly may be connected to the pressure hose, a valve opened (preferably at the sled), and the spray assembly and hose may, while spraying, be drawn through a sewer by a cable or power rod to an end of the desired run, which may be the next manhole; then the valve may be closed, the sled may be removed, and the hose withdrawn. The mixture automatically forms the desired surface-active fumigant, and the spray places the small-bubble foam in contact with all portions of the pipe interior and with all roots inside the pipe. The surface film stays as a foam for a time long enough for full contact and activity by the chemicals involved, without remaining longer than necessary.

Other objects and advantages of the invention will appear from the following description of a preferred form thereof.

In the drawings:

FIG. 1 is a view in side elevation of a trailer-mounted apparatus comprising part of a sewer-spraying apparatus embodying the principles of the invention.

FIG. 2 is a view in front elevation of the apparatus of FIG. 1.

FIG. 3 is a top plan view of a sled and nozzle assembly that may be used in conjunction with the apparatus of FIGS. 1 and 2 in this invention. Alternative "on" and "off" positions of the shut-off valve are shown, one position being shown in solid lines, the other position being shown in broken lines.

FIG. 4 is a view in side elevation of the sled and nozzle assembly of FIG. 3.

FIG. 5 is a view in vertical cross section of a pipe afflicted with roots which, if they grow too massive, will eventually plug the pipe or break the pipe joint, causing infiltration.

FIG. 6 is a similar view showing the sled moving through the pipe of FIG. 5 and spraying it.

FIG. 7 is a fragmentary view in side elevation and in section taken along the line 7—7 of FIG. 6 showing the spray acting.

FIG. 8 is a view on a smaller scale than FIG. 7 showing the assembly of FIG. 3 passing through the pipe and how it is being pulled by cable or power rod. The pipe is broken in the middle to conserve space.

FIG. 9 is a view somewhat similar to FIG. 8 of a modified form of the invention in which a combination cable-hose assembly is inserted through one manhole and pushed to the next manhole, where it is attached to a sled assembly generally like that of FIG. 3.

FIG. **10** is a view similar to FIG. **9**, showing the apparatus of FIG. **9** in use.

FIG. **11** is a view similar to FIG. **10** with a modified form of nozzle on the end of the combination cable-hose.

FIG. **12** is an enlarged fragmentary view in elevation and in section of a cable-conduit combination in which a coil spring encircles a relatively thin-walled plastic conduit.

FIG. **13** is a view similar to FIG. **12** of a modification of the previous unit in which a coil spring cable is inside the conduit.

FIG. **14** is a view of the cable-conduit combination of FIG. **13** with a simple nozzle arrangement attached to one end thereof for use in situations like that of FIG. **11**.

The spray method of the present invention involves coating all surfaces inside a pipe to be treated, with an atomized dilute water solution of the fumigant vapor and surfactant, so that there is an active foam on all the surfaces inside the pipe, including the pipe surfaces, the root surfaces, and the slime-covered surfaces. This coating is done preferably by directing a spray of the material toward the upper portion of the pipe so as to get direct impingement on the roots that tend to grow in the upper portion of the pipe above the normal liquid flow, an area which is more difficult to treat than those areas that can be reached by active agents in the waste water or sewage flow. The active material is deflected and flows down along the pipe walls and other surfaces to cover all the surfaces, including that of the waste water, with foam sufficient for active treatment of the slime, grease and roots in the bottom portion of the pipe. Immediately, the nonionic surfactant carries the alkali metal alkyldithiocarbamate through the water-excluding outer walls of the root into the root and kills the cells therein, and if the root is coated with slime or grease, the surfactant penetrates that too and washes it off, always carrying the fumigant with it. The small bubble foam of this invention has been found to be more stable and to adhere to the surfaces of the roots and other organic material longer than can large-bubble foams, such as fire-extinguisher foam. Treatment of the roots thus is much more efficient because the toxic vapor is held in close proximity to the root cells or surfaces, and also because the foam-forming surfactant is active in cleaning, exposing and penetrating the surfaces—which fire-extinguisher foam is unable to do.

This spray method may be accomplished with the aid of the apparatus shown in FIGS. **1–4**, some parts of which are moved along inside the pipe while the other parts remain outside. FIGS. **1** and **2** show the outside portion of a preferable apparatus, including a trailer **10** having a pair of wheels **11** and carrying a reel **12** of hose **13** and also a set of four tanks **14, 15, 16** (and one not seen in the drawings), which contain the diluted active solution. One end of each of the tanks **14, 15, 16** (and the one not shown) may be connected by a tee **17** and a pressure gauge **18** to an inlet manifold **20**, and the tanks' opposite ends may be connected by conduits **21** to an outlet manifold **22**. The manifold **22** may be connected by a central conduit **23** that extends through the reel **12** to the hose **13** and by the hose **13** to the nozzles **31** and **32** on the sled **30**, shown in FIGS. **3** and **4**.

The pair of atomizer nozzles **31** and **32** are both located approximately at the middle of the sled **30** at a sled manifold **33**. The sled **30** has a skid base **34**, which may be a generally semi-circular shell, for example, defining the lower surface of the sled with front and rear upward ends **35** and **36**, and the center of gravity is kept low, so that the sled **30** rides low along the lower surface of the pipe **25**; consequently, the sprays **37** and **38**, from the nozzles **31** and **32** are directed generally upwardly, as shown in the drawings. Curved guard rods **39** extend across the sled **30** and protect the manifold **33** and nozzles **31** and **32**, helping also to support them. The root-treating liquid is sent into the sled-borne manifold **33** at sufficient pressure, e.g., 110 to 125 psi, to emit the desired sprays **37** and **38**, as by impelling the liquid by nitrogen or other suitable gas under high pressure. A shut-off valve **40** is provided closely adjacent the manifold **33**, with a lever **41** that may be actuated from the street above by pulling on a chain **42** to open the valve **40** or on a cable **43** to close the valve.

As shown in FIGS. **5** and **6**, the root growth **26** occurs only at joints or cracks and tends mainly to be in the upper portion of the pipe **25** (since generally roots cannot live in the oxygen-depleted waste water in the lower portion). This growth **26** is contacted, by the sprays **37** and **38**, and the surfactant acts immediately to remove grease, slime, and other things that might slow the toxic effect upon the roots by the fumigant, while also helping to form a surface-active film in the nature of a small bubble foam on all surfaces inside the pipe **25**. The atomized fumigant solution then is in contact with the roots **26** and acts to release its fungicidal and phytocidal chemicals, largely as vapors; these act in a non-systemic manner to kill only the root portions to which they are actually exposed in the sewer.

The sled **30** may have two rings **44** and **45**, one at each end. The ring **44** may be attached to a cable or wire rope **46** which is used to pull the sled **30** through the pipe **25**. The ring **45** may be attached to a drag line **47** to enable pulling back on the sled **30**, should it encounter an obstacle in the pipe preventing its forward movement. The cable **46** may be secured to the end of a conventional mechanical rodding device after the rod is driven from one manhole **48** to the next manhole **49**. There, the sled **30** with the cable **46** attached to the rod is pulled back through the pipe **25** by the cable **46** and power rod from the manhole **49** to the manhole **48**, and the hose **13** and dragline **47** follow along, the hose **13** unreeling as it goes.

The chain **42** is pulled to move the lever **41** to open the valve **40**, and then the nozzles **31** and **32** are fed continuously with the treating solution, while the sled **30** is moved through the pipe **25** at a substantially constant rate of speed and with substantially constant output. Thereby, the full reaction is obtained and the material is dispersed and acts.

When the sled **30** reaches the manhole **48** and is pulled out by the cable **46**, it is detached from the hose **13**, and the hose **13** and dragline **47** are then pulled back through and out from the manhole **46**. The pipe **25** and all other surfaces between the manholes **48** and **49** have then been coated with a foamy film of small bubbles, which includes the fumigant and surfactant. The fumigant attacks the roots and organic growth generally, and the surfactant carries the fumigant into the inner cells of the roots and attacks grease, slime, and dirt, freeing it from the pipe and from roots and exposing them, rendering the roots liable to attack by the fu-

migant, which displaces the normal sewer atmosphere and is also held in the small bubble foam.

In some installations the power rod and cable **46** and dragline **47** may not be needed. In which case, the power rod and cable **46** may be replaced by a coil spring cable and hose combination **50** as shown in FIG. **9**, the coil spring cable **51** serving to carry the hose **52** through the pipe and to return it and the sled **30** while the spraying is done. It is feasible in short side-lines, and especially small-diameter ones, to use a coil spring cable hose unit **50**, wherein the hose **52** is surrounded by the coil spring cable **51** and is provided with a suitable spray device **53** (FIGS. **11** and **14**) at one end, and to send that out to a desired length and then to spray while pulling the cable-hose unit back.

The cable-conduit unit **50** may be like that shown in FIG. **12** in which a coil spring cable **51** is employed with a thin walled plastic conduit **52** inside it. On the other hand, it may be a unit like the unit **55** shown in FIGS. **13** and **14** in which a coil spring cable **56** is inside the conduit **57**. In fact, as shown in FIG. **15**, a conduit **58** may be molded around a close-wound coil spring cable **59**, the rubber filling the outer cavities between successive coils. The basic point here is that the cable and conduit are made a unit so that it becomes possible to do the pulling with the very unit which is applying the liquid.

The structure may be used as shown in FIGS. **9** and **10** by inserting the cable-hose unit **50** into a pipe **60** via a manhole **61** and driving the cable forward to the next manhole **61**, then attaching to it the sled **30** and then, as in FIG. **10**, pulling the sled **30** along while spraying and then removing the sled **30** from the first manhole **61**.

Another way of using this device with results that are satisfactory for some uses is to install the simple nozzle **53** on the end of a cable-conduit unit **50** or **55** and then pushing the unit **50** or **55** wherever desired and then pulling it back while spraying. In such instance, if the spray is such that it cannot be maintained in a stable position, it may be provided with openings all around so that the spray will reach all portions of the pipe. Naturally, this is somewhat less efficient than with the use of the sled as given before, but it is a feasible way of operating in situations where the sled cannot be used.

To those skilled in the art to which this invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the spirit and scope of the invention. The disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

As pointed out earlier, the spray method has been given extensive and successful trials in city sewers and has worked. One city that uses a closed-circuit television camera inside the sewers with a screen outside the sewers has been able to see the effectiveness by comparisons of the state of the sewer before application with its state afterwards.

I claim:

1. Apparatus for treating root-infested sewer pipes including in combination

a sled having a bottom skid for engaging the lower portion only of a pipe and a low center of gravity and open at its upper end,

means for pulling said sled through a pipe,

upwardly facing spray means for producing a diffuse, foam-inducing spray, mounted on said sled and having upwardly directed nozzles for directing spray against the upper walls only of said pipe, and

means for supplying a liquid aqueous mixture of phytocidal fumigant and surfactant under pressure to said spray means so that a phytocidal foam can be applied to the upper portions especially of said pipe.

2. The apparatus of claim **1**, wherein said nozzles are two in number, each directing upwardly at 45° from vertical on opposite sides of the vertical axis.

3. The apparatus of claim **1** wherein said sled supports valve means for turning on and turning off the flow of said spray means to said means for supplying liquid.

4. The apparatus of claim **3** having elongated means connected to said valve for remote operation thereof.

5. The apparatus of claim **1** having means spraying under pressure at about 100 to 125 psi.

6. The apparatus of claim **1** wherein the means for supplying includes a reel of hose.

7. The apparatus of claim **1** wherein the means for pulling includes a coil spring cable and the means for supplying includes a conduit inside said cable.

8. The apparatus of claim **1** wherein the means for supplying includes a hose and the means for pulling includes a coil spring cable inside said hose.

9. The apparatus of claim **8** wherein said coil spring cable is close wound and the hose is elastomer filling the space outside the coil.

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