United States Patent

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Continuation-in-part of application Ser. No. 616,524, Feb. 16, 1967, now abandoned.

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[54] **WARNING TAPE FOR UNDERGROUND INSTALLATIONS**
10 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **116/67,** 61/72.1, 102/86.5, 206/42
[51] **Int. Cl.** **G08b 3/00**
[50] **Field of Search** ..... 116/114, 67; 206/42, 46, 56 (A3), 65, 3; 23/253 (TP), 230; 102/86.5; 61/72.1; 246/487; 161/95, 127

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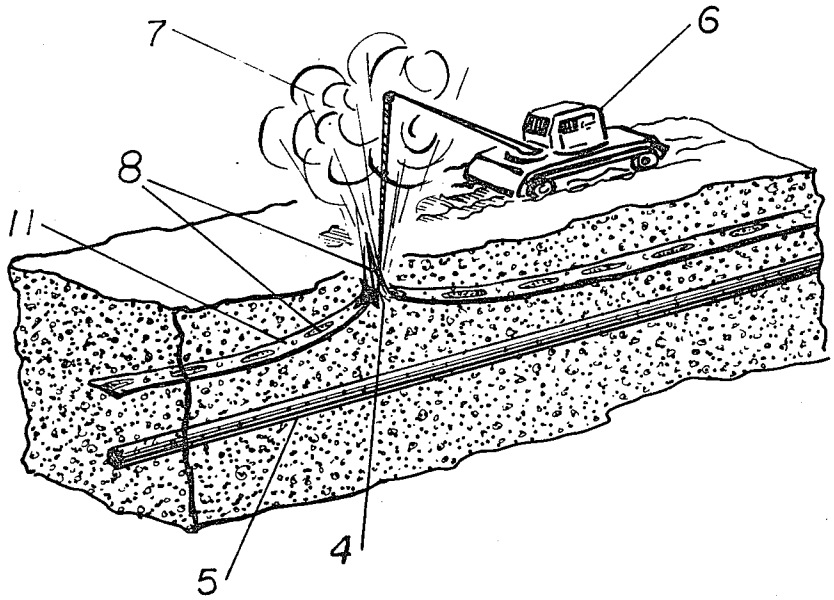
ABSTRACT: A warning tape, to signal the presence of underground installations, which includes capsules containing a smoke-releasing or otherwise attention-compelling chemical substance, released when the tape is ruptured.



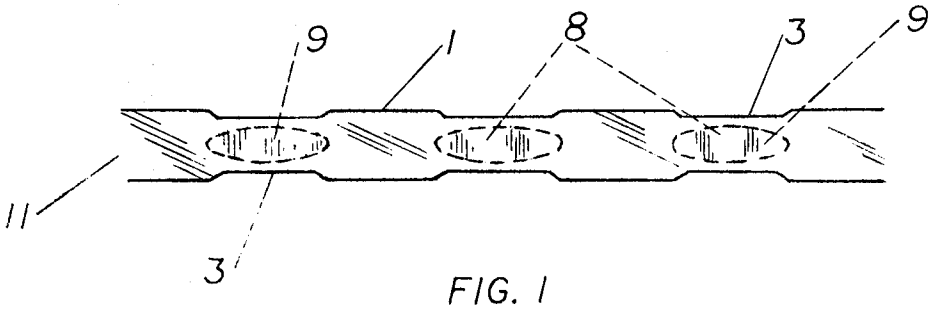


FIG. 1

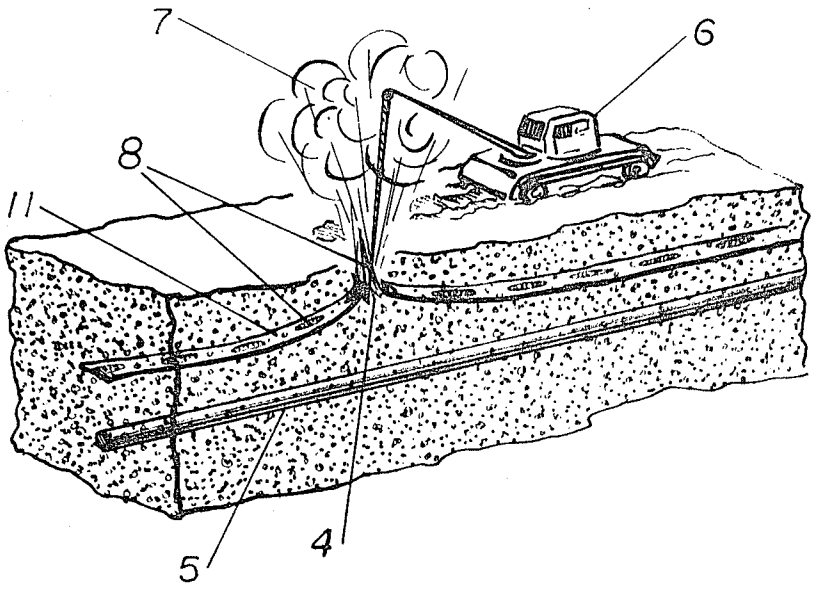


FIG. 2

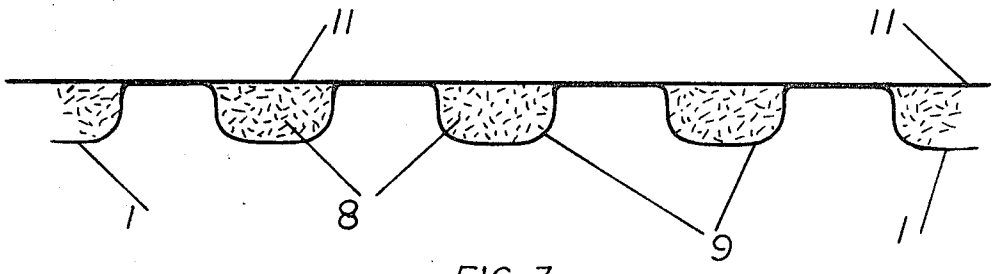


FIG. 3

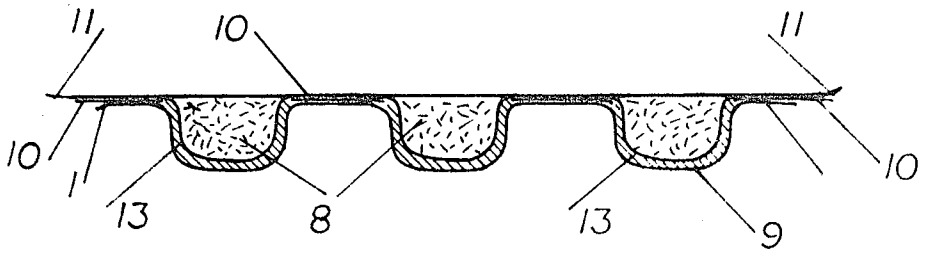


FIG. 4

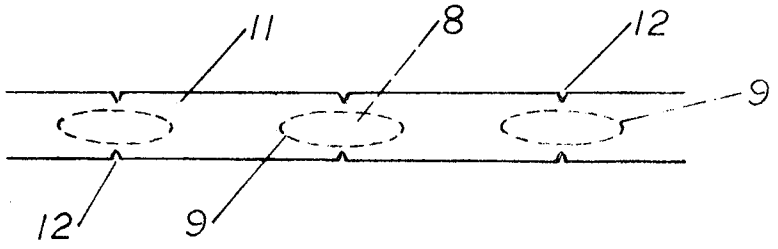


FIG. 5

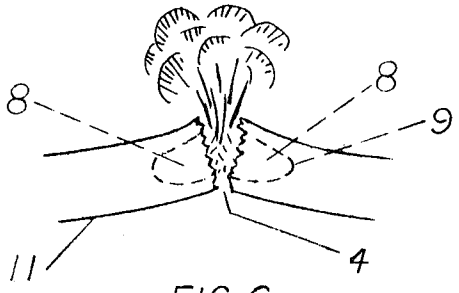


FIG. 6

WARNING TAPE FOR UNDERGROUND INSTALLATIONS

This application is a continuation in part of Ser. No. 616,524, filed Feb. 16, 1967 now abandoned.

This invention relates to safety devices and particularly to a tape, which is to be placed underground to warn those working with digging implements or machines of the presence of underground installations—cables, pipelines, etc.

Heretofore it has been the practice to bury colored plastic film imprinted with a warning message near the surface above such utilities or pipelines, or to mark their presence by the use of readily breakable, low tension lines which sound alarms when broken. However, electrical warnings are dependent on the continued electrical service, and on closely spaced warning signals, and the plastic tape may be overlooked by someone not already alerted to its presence.

An object of this invention is to provide warning means which release attention-compelling signals of a chemical nature, such as a dense smoke, an intense warning odor, a self-igniting gas or the like.

Another object is a novel and superior warning tape.

Another object is a chemically charged warning tape of high dependability.

Further objects will become apparent as the following detailed description proceeds.

In accordance with my invention, I encapsulate a chemical signal agent such as, for example, titanium tetrachloride, silicon tetrachloride, phosphorus, or the like, and dispose it in predetermined spacings in a warning tape in such a manner that mechanical rupture will preferentially continue across such encapsulation so as to liberate its content and set off the chemical signal.

The invention is illustrated by the drawings, of which FIG. **1** is a top view of an embodiment of the warning tape, showing the capsules filled with a chemical warning agent. FIG. **2** is a perspective view of an embodiment of the invention in its practical application of protecting an underground installation. FIG. **3** is a side view of the embodiment of the warning tape, shown in FIG. **1**, showing the capsules. FIG. **4** is a cross section of the tape illustrating the interior coating of a capsule. FIG. **5** is a top view of an embodiment of the warning tape, showing side cuts in the tape, and FIG. **6** is a top view showing break in film causing release of warning chemical.

In the embodiment of the invention shown in FIG. **1** a chemical warning agent **8** is encapsulated in a plastic film assembly **1** so that it will be released when this is torn along any line of least mechanical resistance such as those occurring between corresponding indentations **3** in the constituent plastic film.

These indentations may be stamped out in the edges of the ribbon, or cuts may be made in them in such a way that these cuts, on pulling on the tape, will propagate and will cause a tear across the tape which crosses the area in which the chemically active warning substance is encapsulated, so as to set this free.

The said chemical, when released, will cause a strongly perceptible warning to be sensed, for example, a dense cloud in the case of a hydrolyzable halide such as titanium tetrachloride or an intense odor in the case of a volatile mercaptan such as ethyl- or amyl-mercaptan, or a sound, for example, from a gas expansion effect.

FIG. **2** shows the actual operations of the invention. **5** is a pipeline to be protected by the warning. A trencher **6** is excavating and touches the warning tape. This breaks at **4** thereby releasing the chemical agent **8** which forms the cloud **7**, warning of the presence of underground facilities.

In order to make the release of the warning chemical most positive, and assured, I prefer to enclose it between two laminated films in such a way that the same films form the tape, and the confinement for the warning chemical. In this fashion it is best assured that a crack forming or initiated in one of the films of such a ribbon laminate, will, when pulled or stressed, in effect be propagated across the supply of said warning chemical, setting this free to act.

The films used for this purpose are selected so as to provide good chemical resistance to the particular chemical to be encapsulated. In some cases I may apply a special coating **13** (FIG. **4**), for example a 0.0002 inches vinylidene chloride coating to a corona discharge treated polypropylene film to protect the inner volume not only against slow diffusion of confined titanium tetrachloride to the outside, but also to effectively prevent the diffusion of water vapor from the outside into said tape, so as to cause slow decomposition of the said chemical. To confine amyl mercaptan, a chemical used as warning odor for natural gas, I prefer to use a laminate of two 4-mil films of polyvinyl fluoride. On the other hand, if interreactive chemicals, such as ammonia and hydrochloric acid vapors are to be used, I prefer to employ a fairly thick film made by mixing on a rubber mill 7 percent polyacrylonitril and 93 percent polyethylene and then extruding the resultant plastic "alloy."

I generally prefer to vacuum form, or draw, a series of cups in one of the films, to fill the cup with warning agent, and then to press the other film over said cup so as to seal the same. The seal can be effected by a very rapid heat sealing process, but I prefer to employ an infrasound impingement sealing process, for which commercial equipment is readily available, or to use an adhesive. For example, when the tapes are made of 5-mil calendered polyvinyl chloride, I use a 10 percent solution of polyvinyl chloride in dimethyl ketone as the adhesive to bind the films together and to seal the warning chemical.

I may even use as heavy tape as 12-mil, though the preferred range is 2- to 6-mil.

In order to ensure the release of the warning chemical when the tape is ruptured, I may deliberately weaken the tape at selected points, for example by cutting or by perforation or embossing, or by using selectively thinner films in the areas in question.

Reference is made to FIG. **3** which shows a single base film, in which cups **9** have been made by the use of any of the applicable well-known techniques, such as drawing or vacuum forming. These cups are filled with the warning chemical **8**, whereupon (FIG. **4**) another film **11** is sealed or adhered so as to bond to the noncupped portion of the first film, thus closing the cups in which the warning chemicals lodge. **10** (FIG. **4**) indicates an adhesive binding the two films together, although direct fusion by high frequency ultrasonic, or thermal techniques is also possible.

FIG. **5** shows the same tape from above, side cuts **12** weaken the film so that when it breaks, the break will occur across a cup thus releasing the warning chemical, as illustrated in FIG. **6**.

Such lines of least resistance can also be achieved by indenting or otherwise modifying the film to reduce the width of the film locally, the rupture then occurring along a line at the narrowest point of the plastic proximate to the rupturing stress concentration, or it may be achieved by localized etching or other similar mechanical or chemical localized weakening means, or by any other means of creating weakened tear zones, along which it can be safely predicted that any tearing will occur.

To confine the chemical warning agent it is often desirable or necessary to use a special frangible container, or if it is laminated or injected into areas between plies of a laminated film it may be necessary or desirable to have this coated on the inner side with a coating more resistant and or less permeable to the chemical agent itself or to oxygen or moisture that could affect it, than is the film principally used in the warning device. For example, if a polyethylene, or other thermoplastic olefins are used in the carrier film or if polyvinyl chloride film is used, it may be necessary or desirable to coat it with vinylidene chloride or fluoride in order to minimize penetration. This also applies to the lower mercaptans; even amyl mercaptan is quite penetrating and requires special coatings to effectively confine it, such as polyfluoroethanes or polybenzimidazoles. With hypergolic liquids such as ethyl zinc or aluminum alkyl, the importance of adequate confinement is

still more obvious; stronger films in sandwich construction and multiple coatings are here preferred.

It is thus seen that the invention is capable of considerable variation and is not to be limited excepting by the claims, in which it is my intention to cover all novelty inherent in this invention as broadly as possible in view of prior art.

Having thus disclosed my invention, I claim:

1. A warning device for operation underground, comprising:

an elongated extended member consisting essentially of synthetic resinous material,

said member comprising a plurality of longitudinally spaced apart weakened tear zones, and

said member comprising a plurality of longitudinally spaced apart fully enclosed compartments

each of said compartments containing a chemical warning substance which manifests its presence remotely from said compartment when said compartment is ruptured

each of said compartments disposed in said member so that one of said weakened tear zones extends across said compartment so that rupture of said member at said tear zone ruptures said compartment.

2. The device of claim 1 in which said chemical warning substance is a smoke releasing material.

3. The device of claim 1 in which said chemical warning substance is an odiferous substance.

4. The device of claim 3 in which said chemical warning substance is a volatile mercaptan.

5. The device of claim 1 in which said chemical warning substance is sound producing.

6. The device of claim 5 in which said chemical warning substance is a hydrolyzable volatile.

7. The device of claim 1 in which said weakened tear zones are provided by indentations.

8. The device of claim 1 in which said weakened tear zones are provided by perforations.

9. The device of claim 1 in which said weakened tear zones are provided by cuts.

10. The device of claim 1 in which said elongated member consists essentially of a tape member made as an interrupted laminate of two tape members wherein interruptions in said lamination provide said compartments.