Title: WEED EXTERMINATOR AND METHOD OF EXTERMINATING WEED

Abstract: The invention relates to a method of exterminating weed, which method comprises the steps of: providing an extermination chamber (14, 14a, 14b, 14c) having at least one open side (14d), placing the open side (14d) over weed to be exterminated; substantially closing off the edge of the open side of the extermination chamber (14, 14a, 14b) and the ground or soil in which the weed is present; providing a refrigerant in the extermination chamber (14, 14a, 14b, 14c); keeping the extermination chamber (14, 14a, 14b, 14c) in place for a length of time sufficient to exterminate or kill the respective weed by means of the refrigerant while the exterminator moves forward. The invention further relates to a weed exterminator (1) having at least one extermination chamber (14, 14a, 14b, 14c) having at least one open side (14d).
Title: Weed exterminator and method of exterminating weed

The invention relates to a weed exterminator and a method of exterminating weed. More particularly, the invention relates to damaging and exterminating weed by means of cold, and optionally then removing it.

For exterminating weed, various methods and devices are known.

These can be classified into a number of categories. For instance, the weed may be damaged, exterminated and/or removed manually, mechanically, chemically or thermally. Thermally damaging, exterminating and/or removing weed may be carried out by means of heat with a burner or by means of steam. Also, the weed may be damaged and/or exterminated by exposing it to cold.

Although weed extermination can be carried out mechanically, chemically, biologically and/or thermally, at a number of specific locations only a limited number of these technologies are deployable. For instance in harbor areas and/or at (petro-)chemical complexes, it is undesirable to work with flammables and/or (open) fire. There, for reasons of safety, the use of volatile flammables and/or elevated temperatures is normally not allowed. Therefore, weed is removed manually at such locations and/or damaged or exterminated with cold. Manual removal of the weed, however, requires deployment of manpower.

From the prior art, a number of weed exterminators and/or methods of exterminating weed by means of cold are known. Such a method can for instance be derived from the German utility model DE29 607 745. In this utility model, a weed exterminator is described which exterminates the weed by means of liquid air. This liquid air is manually applied through a hose via a trapezoid accessory onto the weed grown surface.

A disadvantage of such a system is that the liquid air due to its low viscosity can simply flow away out of the accessory. To accomplish with this exterminator a complete or at least a sufficient destruction of the weed
in question, the weed needs to be exposed to the cold medium for a relatively long time. Firstly, the accessory then needs to be pressed firmly onto the ground to prevent escape of the cold medium. Secondly, the accessory also needs to be pressed against the ground for a relatively long time to effect an adequate extermination. Accordingly, extermination in this way requires a considerable amount of force and patience of the operator in charge of exterminating the weed. Consequently, the use of this system is comparatively impractical.

An object of the invention may be to provide a device and a method for exterminating weed that do not have or at least eliminate in part the above-mentioned disadvantages. Another object may be to provide a device that is more efficient in the use of refrigerant, preferably more practical in use, and can effect better extermination. Yet another object may be to accomplish extermination with a minimal staff loading in a preferably safe and environmentally friendly manner.

At least one of these and/or other objects is achieved with an extermination method in which an exterminator with an extermination chamber is used. The extermination chamber is arranged with the open side around or over the weed to be exterminated, after which a refrigerant is provided in the extermination chamber. The extermination chamber is held around the weed for a length of time to effect adequate extermination of the weed while the exterminator moves forward.

In the dependent claims, further embodiments of the invention are elaborated.

The invention will be further elucidated on the basis of exemplary embodiments represented in the drawing. In the drawing:

Fig. 1a shows a schematic sectional view along the line AA' in Fig. 1b;

Fig. 1b shows a schematic top plan view of a first embodiment of the invention;
Fig. 2 shows a schematic sectional side view of a second embodiment of the invention;

Fig. 3 shows a schematic sectional side view of a third embodiment of the invention along the line BB' from Fig. 4;

Fig. 4 shows a schematic bottom view of the third embodiment of the invention;

Fig. 5 shows a schematic sectional side view of a fourth embodiment of the invention along the line CC' from Fig. 6;

Fig. 6 shows a schematic bottom view of the fourth embodiment of the invention;

Fig. 7 shows a schematic sectional side view of a fifth embodiment of the invention;

Fig. 8 shows a schematic bottom view of a sixth embodiment of the invention.

In the drawing, equal or corresponding parts are indicated with corresponding reference numerals.

It is noted that the drawing is only a schematic representation of embodiments of the invention. The drawing should not in any way be construed as limiting the invention.

Fig. 1 shows a side view of a weed exterminator 1 according to a first embodiment. The weed exterminator comprises an extermination chamber 14, in which outlets 2 are arranged, from which refrigerant can flow according to need. The outlets 2 may then be designed as spray nozzles. The outlets 2 may also be designed as open tube ends, atomizers and/or other directors or sprayers. The outlets 2 are arranged on a manifold line 3, which is in fluid communication with a line 4. The manifold 3 is in fluid communication with a storage tank 6 via a shutoff 5 and via line 4. The shutoff 5 may for instance be designed as a (regulating) valve, a cock and/or other known shutoff.
The extermination chamber 14, as viewed in the direction of movement x, is bounded at the front by a front wall 9, a rear wall 10 and two sidewalls 9a and 9b indicated in Fig. 1b. The walls 9, 9a, 9b and 10 are provided on the ground side thereof with sealings 11 and 12. The sealings provide for a sealing of the extermination chamber 14 with respect to the ground, so that no refrigerant, or as little as possible, can flow out of the extermination chamber 14. These sealings 11 and 12 can comprise or consist of one or more rubbers lips, brush seals and/or other close-off elements.

The front wall 9, the sidewalls 9a, 9b and the rear wall 10 are connected at the top with a cover plate 13. Through this cover plate 13 extends the line 4. The cover plate may be of closed design or can comprise openings 13a. The openings 13a can prevent an undesired pressure buildup of the evaporating refrigerant in the extermination chamber 14.

The shutoff 5 may be controlled by a sensor 7. Here, the sensor 7 is designed, for instance, as an infrared reflection meter, which registers whether a plant is in front of the exterminator 1. If so, the sensor can give a signal which by means of a processing unit 19 is converted into a control signal for the shutoff 5. The processing unit 19 can for instance comprise a control computer, such as for instance a PLC and/or another control system.

The weed exterminator 1 is moved during use in the direction x over a terrain or a ground where possibly unwanted weed grows. Here, the exterminator may for instance be attached to a vehicle or be part of a vehicle especially arranged for weed extermination. If presently the sensor 7 registers a plant or weed, the shutoff 5 is opened, for instance after a short time delay. As a result, refrigerant flows out of the storage tank 6 through the line 4 and through the manifold 3 through one or more outlets 2 into the extermination chamber 14.
Alternatively, the sensor 7 may also be situated in the extermination chamber 14. In that case, a time delay is not necessary and the shutoff 5 can be opened as soon as an unwanted plant is registered by the sensor 7.

As a result of the use of a time delay, the exterminator has meanwhile moved forward so that the space 14 moves substantially around and/or above the weed. The time delay may be substantially equal to the speed of travel of the exterminator 1 times the distance, viewed in the direction x, between the sensor 7 and the extermination chamber 14. As the refrigerant flows into the extermination chamber 14, the plant is exposed to it. Due to the low temperature of the refrigerant, this results in a considerable heat transfer from the plant to the refrigerant. As a result, the plant can lose so much heat that at least a part of the structures contained in the plant freeze and/or change in structure to the extent where the plant is irreparably damaged and dies. The sealings 11 and 12 provided on the lower end of the walls 9, 9a, 9b and 10 press onto the ground, such that as little refrigerant as possible escapes along the lower edge of the walls 9, 9a, 9b and 10 and along the sealings 11 and 12.

In the use of the exterminator 1 of Fig. 1, it is preferred to keep the extermination chamber 14 around and/or above the plant for a length of time to expose the weed to the refrigerant sufficiently long. For this purpose, for instance the speed of travel and/or the length of the extermination chamber 14 in the direction of travel x can be optimized to effect a sufficient extermination.

For a still more thorough extermination, multiple extermination chambers 14, 14b may be connected behind each other, as is shown in Fig. 2. Here, behind the first extermination chamber 14 around the plant, there is again a sensor 7a and then a second extermination chamber 14a. The second extermination chamber 14a, like the first extermination chamber 14, can be designed with a front wall 9, a rear wall 10 and two sidewalls 9a, 9b. In the second extermination chamber 14b there is
likewise a manifold 3a with a number of outlets 2a. The manifold 3a is in
fluid communication with the storage tank 6 via the line 4 and the shutoff
5. The shutoff 5a may be controlled by the sensor 7a in a same manner as
the shutoff 5 is controlled by sensor 7. The sensor 7a may for instance be
designed as an infrared reflection meter. The sensor 7a can then register,
for instance, whether the plant has been exposed to sufficient cold. If such
is not the case, the sensor 7a may for instance control the shutoff 5a. In
this way, the plant is exposed to the refrigerant a second time in the
extermination chamber 14a.

Exposing the plant to the refrigerant long enough may alternatively
be carried out by keeping the extermination chambers 14, 14b in place
during travel of the exterminator 1.

This may be elegantly carried out by providing the extermination
chambers 14, 14b in, around or on the outside of a caterpillar track 24.

Fig. 3 shows an example of such a caterpillar track 24. In this embodiment,
a number of extermination chambers 14b with an open outer side have
been arranged in a caterpillar track 24. The extermination chambers 14b
are provided with an opening 15 on the caterpillar track inner side,
through which the refrigerant can be supplied to the extermination

chambers 14b. The caterpillar track 24 may be arranged around a first
roller guide 20 and a second roller guide 21. The roller guides 20 and 21
are rotatably arranged on shafts 22 and 23 and can keep the caterpillar
track 24 in the proper position. The roller guides 20 and 21 may then be
designed, for instance, as traveling wheels, traveling rolls and/or travelling
drums. In Fig. 4 a bottom view of the caterpillar track 24 is represented. In
the width of the caterpillar track with respect to the direction of travel x, a
number of extermination chambers 14 are arranged side by side. The
openings 15 are here designed as slots in order that during travel of the
exterminator 1 the refrigerant is supplied to the extermination chambers
14b of the caterpillar track 24 for some time without the refrigerant thereby flowing away undesirably via the edges of the openings 15.

On the open outer side of the extermination chambers 14b, sealings 12b are arranged. These sealings 12b may comprise or consist of strips, lips and/or sealing brushes.

Viewed in the direction of movement x, in front of the caterpillar track a sensor 7b is arranged, which is connected through signal technology with a control unit 19. The control unit 19 in turn is connected through signal technology with the shutoff 17. When presently the sensor 7b registers a plant, a signal is passed to the control unit 19. After a suitable time delay which substantially corresponds to the time of travel of the exterminator over the distance, viewed in the direction of travel x, between the sensor 7b and the outlet 2 of the line 16, the control unit 19 passes a control signal to the shutoff 17. As a result, the shutoff 17 opens and the refrigerant flows from the storage tank 6b, via the line 16, the shutoff 17 and the outlet 2 through the opening 15 into the extermination chamber 14b. Now, by designing the opening 15 as a slot whose longitudinal direction corresponds substantially to the direction of movement x, the refrigerant can keep flowing into the extermination chamber 14b for some time while the exterminator 1 advances.

Fig. 3 represents a side view of the exterminator 1a in section, so that only one outlet 2 is visible. There may also be a number of outlets 2 situated in a row transverse to the direction of travel. The number of outlets 2 then corresponds to the number of rows of extermination chambers 14b, such as they are represented in the bottom view of the caterpillar track 24 in Fig. 4. Here, each outlet 2 may be in fluid communication with the storage tank 6b via a separate line 16 and a separate shutoff 17. A row of sensors 7b is then situated, viewed in the direction of travel x, in front of the caterpillar track 24. Each individual
sensor 7b may then control the shutoff 17 situated behind it, viewed in the
direction of travel x, via the control unit 19.

Above the extermination chambers 14 resting on the ground, a
supporting plate 25 may be arranged, along which the caterpillar track 24
can be pressed onto the ground. The supporting plate 25 may also screen
off and/or at least partly close off the openings 15.

The caterpillar track 24 may for instance be manufactured from a
rubber molded part, an elastic cloth, and/or other suitable materials. The
material may then be chosen such that it remains elastic also when under
exposure to the refrigerant. Also, the material may be provided with an
extra insulating layer and/or a reflecting layer which protects the material
from the action of the cold of the refrigerant. A reflecting layer can for
instance comprise an aluminum foil.

In Fig. 5, in sectional side view, an alternative embodiment of the
exterminator 1b is represented. Fig. 6 is a bottom view of the exterminator
1b. Fig. 5 shows a sectional view of the exterminator 1b along the line CC'
which is represented in Fig. 6. In Fig. 5 an exterminator 1b with a
caterpillar track 24a is shown, which is arranged about two roller guides
20a and 21a. The roller guides 20a and 21a are rotatably connected with
shafts 22a and 22b, respectively. Arranged on the caterpillar track 24a are
flexible walls 26 directed transversely to the direction of travel x.
Furthermore arranged on the caterpillar track 24a are flexible walls 27
substantially in the direction of travel x. The walls 26 and 27 here form a
grid or a matrix of extermination chambers 14c.

As the walls 26 and 27 are manufactured from flexible material, a
good sealing between the ground and the extermination chambers 14c can
be obtained. Fig. 5 shows the bottom side of the caterpillar track 24a. Here,
again, the extermination chambers 14b are provided on the caterpillar
track 24a in the form of a grid or a matrix of rows and columns.
In Fig. 7, viewed in the direction of travel x, behind the extermination chamber a cleaner 28 is arranged for removing and/or pulverizing the exterminated weed. The cleaner 28 may be designed as a brush rotating about an upstanding shaft 29. However, it may also consist of a plurality of smaller brushes 30, as represented in Fig. 8. The brushes 30 could then each individually be rotatably arranged, so that only the brush 30 having an exterminated plant coming into its vicinity may be set into operation. The information collected by the sensor 7 may then, for instance, also be passed on to the individual actuators of the individual brushes 30 via the control unit 19. Also, the cleaner 28 could alternatively be designed, for instance, as a brush roller rotating about a horizontal shaft, a rake, a scraping iron, blade, mower, and/or otherwise.

As the cleaners 28 or 30 are placed directly behind the extermination chamber 14, the exterminated plant can be brushed away while still in wholly or partly frozen condition. Due to this frozen state, the plant may then be particularly brittle and fragile, which can facilitate brushing the plant away.

In the embodiments as represented in Figs. 1, 1a and 2, alternatively, the cleaner 28 may also be arranged in the extermination chamber 14, 14a. In this way, the weed can be brushed away and/or pulverized in frozen condition. Also, by simultaneous exposure to the refrigerant and to the mechanical action of the cleaner 28, the effect of extermination is enhanced.

With the embodiments according to the invention, an extermination chamber 14, 14a, 14b, 14c can be moved over a terrain. The weed is then exterminated each time by placing the extermination chamber 14, 14a, 14b, 14c by at least one open side 14d thereof around and/or over the weed to be exterminated. The sealing 11, 12, 12b, 12c provided on the lower edge of the open side 14d of the extermination chamber 14, 14a, 14b, 14c is thereby pressed against the ground or soil in which the weed is present. As
a result, the sealing 11, 12, 12b, 12c substantially closes off the extermination chamber 14, 14a, 14b, 14c. After the extermination chamber has been placed around or over the weed to be exterminated, an amount of refrigerant is added to the extermination chamber. This refrigerant can comprise a liquefied gas such as for instance oxygen, nitrogen and/or carbon dioxide. These gases have the advantage of being hardly reactive and/or being hardly, or only in high doses, harmful to health. Furthermore, these gases have very low atmospheric boiling points, so that upon exposure to the atmosphere they boil at very low temperatures, and thereby can draw their evaporation heat from the plants to be exterminated. By keeping the extermination chambers 14, 14a, 14b, 14c around and/or over the weed for a particular length of time, the weed in question can be destroyed and killed.

The users of the weed exterminator can for instance be landscaping companies, municipal parks departments, dock industries, storage yard managers, cleaning and/or maintenance services of (petro-)chemical complexes.

It is noted that the invention is not limited to the exemplary embodiments discussed here. For instance, in a number of extermination chambers 14b, 14c of the caterpillar tracks 24, 24a a reduced pressure may be created, so that the caterpillar track 24, 24a is pressed against the ground with a greater force. As a result, the extermination chambers 14b seal off still better, so that less refrigerant can escape. On the walls 9, 9a, 9b and 10 and/or the cover plate 13 of the extermination chambers a reflecting foil may be arranged for still better insulation of the cold present in the extermination chamber from the surrounding walls and cover plate.

As an example of a sensor 7, an infrared sensor is described. It will be self-evident that this sensor 7 may also be designed as a different sensor or camera. Then, for instance, the images generated by a camera can be analyzed by means of pattern recognition software. Diverse different plant
species and their size may then be recognized. With this information, the
dose of the refrigerant may then be adjusted, for instance to the size,
species and number of plants.

The outlets 2 are represented as open tube ends in the drawing.

Alternatively, these may also be designed as injectors such as, for instance,
aimed (injection) needles, which can apply the refrigerant into or near the
plant or the roots thereof.

The storage tank may optionally be designed with a weighing
system to monitor what amount of refrigerant is being used and how large
the residual supply in the storage tank is.

As an alternative to the walls of the extermination chamber, for
instance, aimed air streams may keep the refrigerant in place.

These and other variants will be apparent to those skilled in the art
and are understood to be within the scope of the invention as set forth in
the following claims.
CLAIMS

1. A method of exterminating weed using an exterminator (1, 1a, 1b), comprising the steps of:
   - placing an open side (14d) of an extermination chamber (14, 14a, 14b, 14c) over the weed to be exterminated;
   - providing a refrigerant in the extermination chamber (14, 14a, 14b, 14c);
   - keeping the extermination chamber (14, 14a, 14b, 14c) in place for a length of time sufficient to exterminate or kill the respective weed by means of the refrigerant, with the exterminator (1, 1a, 1b) moving forward.

2. A method according to claim 1, wherein the edge of the open side (14d) of the extermination chamber (14, 14a, 14b, 14c) and the ground or soil in which the weed is present is substantially closed off.

3. A method according to claim 1, wherein the refrigerant comprises a liquefied gas.

4. A method according to any one of the preceding claims, wherein the extermination chambers (14a, 14b) are arranged in, on and/or around a caterpillar track (24, 24a).

5. A method according to any one of the preceding claims, wherein the weed after being exterminated is removed and/or pulverized.

6. A method according to claim 4, wherein removing is done by means of at least one cleaner (28, 30).

7. A method according to claim 5, wherein the cleaner (28, 30) during removal of the weed performs at least a first rotary movement.

8. A method according to any one of the preceding claims, wherein the weed is registered and the provision of the refrigerant is actively controlled depending on the registration of the weed.
9. A method according to any one of the preceding claims, wherein extermination takes place on harbor and/or storage sites and/or petrochemical complexes.

10. A method according to claim 9, wherein extermination takes place around and near storage tanks containing flammable and/or explosive substances.

11. A weed exterminator (1), comprising at least one extermination chamber (14, 14a, 14b, 14c) having at least one open side (14d).

12. A weed exterminator (1) according to claim 11, wherein in or near the extermination chamber (14, 14a, 14b, 14c) an outlet (2) for introducing refrigerant is arranged.

13. A weed exterminator (1) according to any one of claims 11 or 12, comprising a storage tank (6, 6b) and a line (3, 4) for dosed feed of refrigerant into the extermination chamber (14, 14a, 14b, 14c).

14. A weed exterminator (1) according to any one of claims 11-13, wherein one or a plurality of extermination chambers (14, 14a, 14b, 14c) are arranged in, on and/or around a caterpillar track (24, 24a).

15. A weed exterminator (1) according to any one of claims 11-14, comprising a cleaner (28, 30) for removing the exterminated weed.

16. A weed exterminator (1) according to any one of claims 11-15, wherein the exterminator is mountable in or on a vehicle.

17. Harbor site, storage site and/or chemistry complex having thereon a weed exterminator (1) according to any one of claims 11-16.

18. The use of a weed exterminator (1) according to any one of claims 11-16 for exterminating weed on harbor sites and/or (petro-)chemical complexes.
FIG. 2

FIG. 3
FIG. 5

FIG. 6
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. A01M21/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A01M E01H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Category</th>
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Date of the actual completion of the international search: 13 November 2009
Date of mailing of the international search report: 24/11/2009

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Authorized officer
Moeremans, Benoit
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