

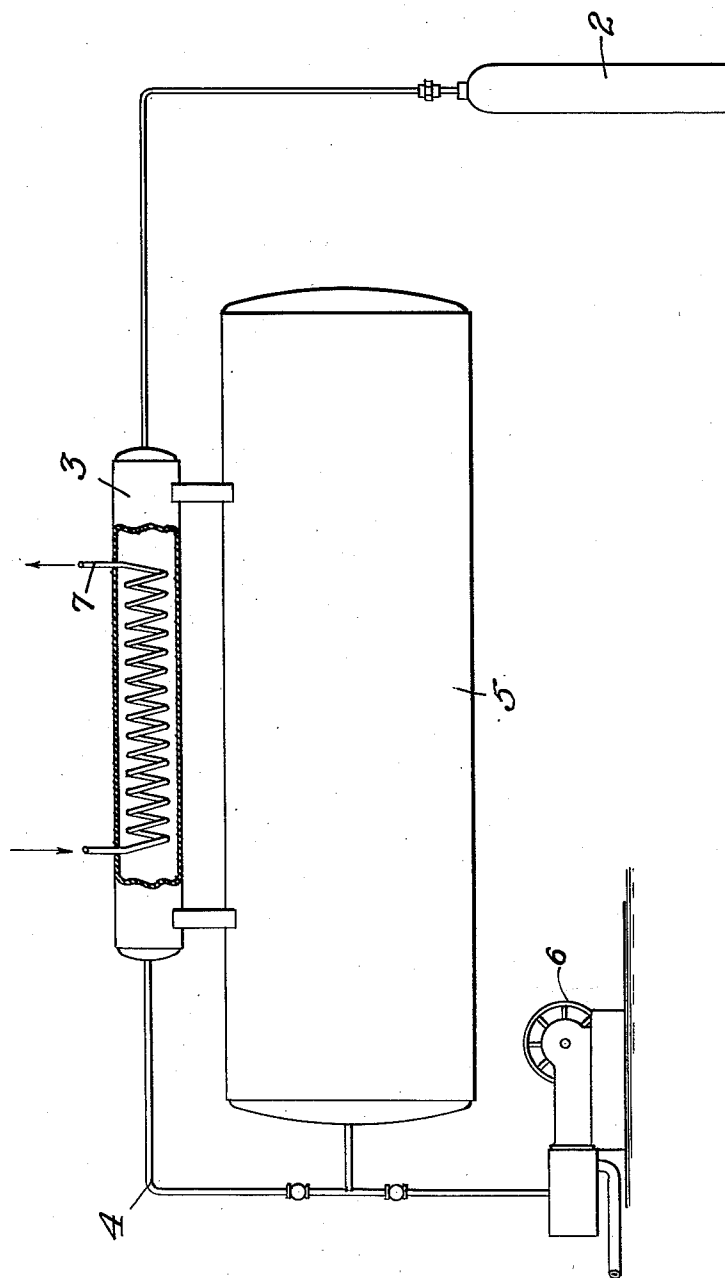
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METHOD OF FUMIGATION

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METHOD OF FUMIGATION

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This invention relates to an improved method of fumigation, and particularly to the fumigation of vegetable products with a mixture of vapors from volatile liquids.

5 In carrying out fumigation of food or other vegetable and animal products, a mixture of vapors is customarily supplied. The vapors are taken from the liquids, which are supplied in tanks under pressure. Generally the fumigant
10 comprises carbon dioxide or other inert gas such as nitrogen or the like, together with a minor proportion of toxic gas such as ethylene oxide, methyl formate or the like. For example, a preferred fumigant comprises 9 parts by weight
15 of carbon dioxide and 1 part by weight of ethylene oxide.

In commercial practice, the fumigating materials are supplied in liquid form, the liquids being placed in the desired proportion under high
20 pressure in a steel tank. The liquids commonly used may not be miscible in the proportions used.

On this account removal of vapors in the proportions in which the liquids are present is not possible under present methods. If the outlet
25 is from the bottom of the tank the heavier liquid comes off first, whereas if vapors are removed from the top, the more volatile comes off in excessive amounts in the beginning and the less volatile in excessive amounts at the end.
30 Attempts have been made to remedy this situation by the use of multiple hole inductor tubes, and while these have helped considerably, they by no means overcome the difficulty. The changes from the desired proportions will cause
35 very considerable variations in the efficiency of the fumigation, and many fumigation failures are directly traceable to variations in the proportions of the constituents.

Also in the case of liquids which may be more or less completely miscible, removal of vapors in the proportions in which the liquids are present
40 may be impossible or difficult, under present methods, because the evaporation rates may not correspond to the desired mixture.

45 By means of the present invention, vapors are supplied in exactly the predetermined and desired proportions, and in perfectly homogeneous form.

The invention is illustrated diagrammatically in the drawing, wherein is shown a liquid container 2 from which the vapors may be removed to the accumulator 3. The mixed vapors from the accumulator are passed through the line 4 into the fumigator 5. A vacuum pump 6 is provided in order to evacuate the fumigator if desired.
55 The accumulator 3 is also provided with

means for heating the vapors, as for example a steam coil 7.

In carrying out the process the tank 2, containing the liquids, the vapors of which are to be used as fumigants, is connected to the accumulator. If immiscible, liquids will not mix
5 within the tank, but the lighter will float upon the heavier. In carrying out the invention, substantially the entire contents of the liquid tank 2 are then evaporated into the accumulator 3, or
10 until the pressure in the two are substantially equal, and are mixed within the accumulator to form a homogeneous mixture before admission to the fumigator. After thoroughly mixing in the accumulator, during which time the gases are
15 preferably heated to a temperature of the order of 120° F., they may be admitted to the fumigator.

In the preferred method of fumigation, the products to be fumigated are placed within the fumigator 5, which is evacuated to a pressure of
20 $\frac{1}{2}$ " of mercury absolute or less, and the fumigating gases are then admitted and the total gas pressure brought up thereby to 15–20" of mercury absolute. The gases are maintained at a considerable pressure in the accumulator 3, for example, 75 lbs., and it is found that there is no separation of the gases upon their subsequent rarefaction in the fumigator. Therefore, being
25 mixed in the proper proportions in the accumulator, the drop in pressure therein has no effect upon the proportions and the fumigator is always supplied with precisely the desired ratio of vapors.

As an example of the invention, 6 lbs. of ethylene oxide and 54 lbs. of liquid carbon dioxide are provided in a pressure tank, under a pressure of
35 roughly 800 lbs. per square inch. These materials are then vaporized into an accumulator having a capacity of in the neighborhood of 100 cubic feet. This will involve a reduction of pressure to about 75 lbs. The vapors are admitted to
40 the accumulator under a fairly high pressure drop so that mixing is promptly and completely secured. When the entire quantity of liquid has vaporized, the liquid tank may be disconnected. If desired, more than one tank full of liquid may
45 be vaporized into the accumulator. In each case it is important to evacuate the entire container, however.

The vapors within the accumulator are preferably heated to a temperature of 120° F. It has
50 been discovered that by supplying the gases at this temperature the fumigation is considerably assisted.

The product to be fumigated, for instance tobacco, food products or the like, is then placed
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within the fumigator, which is closed and evacuated. After the desired degree of vacuum has been secured the mixed and heated vapors are then admitted to the tank, the pressure being raised thereby, and are held within the fumigator for the desired period, for example two or three hours.

The term "liquid", as used herein, denotes materials of approximately liquid density, whether actually above or below the critical point.

The term "immiscible", as used herein, denotes materials which are not completely miscible in the proportions in which they are used as fumigants, so that there is a division between the materials.

The foregoing description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, but the appended claims should be construed as broadly as permissible, in view of the prior art.

What I claim as new and desire to secure by Letters Patent is:

1. The method of fumigation which comprises completely volatilizing liquid carbon dioxide and ethylene oxide from a common container, the carbon dioxide being present in major proportion and the ethylene oxide in minor proportion, thoroughly admixing the vapors therefrom, and fumigating with said mixed vapors.

2. The method as set forth in claim 1, in which the liquids are present in the proportions of the order of 9 parts carbon dioxide to one part of ethylene oxide.

3. The method of fumigating with mixtures of ethylene oxide and carbon dioxide, which comprises expanding a liquid charge containing said ingredients in the desired proportions to completely gasify the same, retaining the completely gasified charge in gasified form until it becomes homogeneous, and subsequently applying gas from the charge to the articles to be fumigated.

4. The method of fumigating with mixtures of ethylene oxide and carbon dioxide, which comprises charging a container with the liquid ingredients in the proportions desired for fumigating, expanding substantially the entire container charge into gaseous form, and retaining the expanded gaseous charge before application to the articles to be fumigated until it becomes entirely homogeneous in the gaseous form.

5. The method of fumigating with mixtures of methyl formate and carbon dioxide, which comprises expanding a liquid charge containing said ingredients in the desired proportions to completely gasify the same, retaining the completely gasified charge in gasified form until it becomes homogeneous, and subsequently applying gas from the charge to the articles to be fumigated.

6. In the fumigation of insect pests with a mixed vapor from a charge of liquid ethylene oxide and carbon dioxide, the steps of completely volatilizing said liquids, thoroughly admixing the vapors therefrom, heating said vapors to a temperature of the order of 120° F., and introducing said heated vapors into a vacuum zone containing the material to be fumigated.

7. In the fumigation of insect pests with a liquid charge of ethylene oxide and carbon dioxide, the steps of completely volatilizing said liquids thoroughly admixing the vapors therefrom, heating said vapors to a temperature of the order of 120° F. under a pressure of 75 lbs., and introducing said heated vapors into a vacuum zone containing the material to be fumigated.

8. The method as set forth in claim 7, in which the vapors are collected under a pressure of the order of 75 lbs. superatmospheric, and said fumigation is carried out under an air pressure of the order of ½ inch of mercury.

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