H. ANHALTZER.

METHOD OF GENERATING FORMALDEHYDE GAS.

APPLICATION FILED JUNE 12, 1914.

1,191,647. Patented July 18, 1916.

FIG. 3

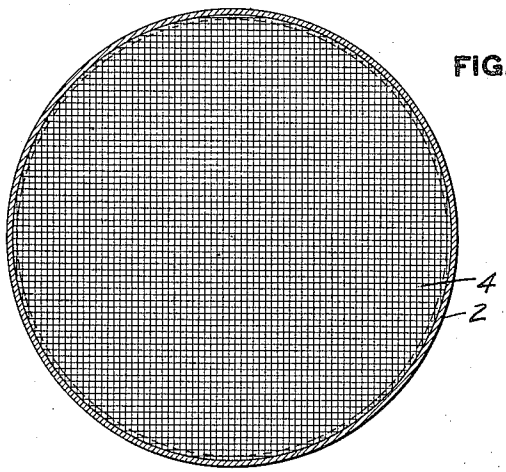
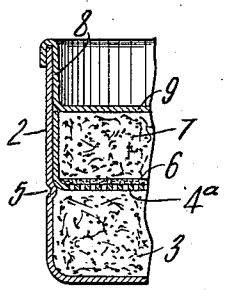


FIG. 4



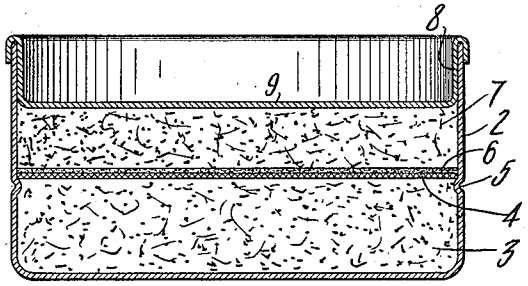


FIG. 1

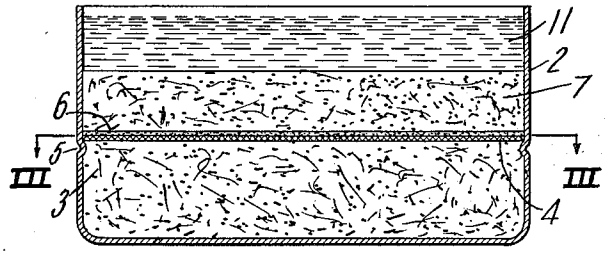


FIG. 2

WITNESSES

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METHOD OF GENERATING FORMALDEHYDE GAS.

1,191,647. Specification of Letters Patent. Patented July 18, 1916.

Application filed June 12, 1914. Serial No. 844,694.

To all whom it may concern:

Be it known that I, HENRY ANHALTZER, a citizen of the United States, and resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Methods of Generating Formaldehyde Gas, of which the following is a specification.

My invention has relation to disinfecting, fumigating and deodorizing by means of formaldehyde and more particularly by means of formaldehyde gas.

Heretofore it has been the practice to use formaldehyde both in its solid form and in solution for the purpose of disinfecting and fumigating. It is necessary to heat formaldehyde in its solid form to generate and liberate the formaldehyde gas and in the existent methods the heat necessary is supplied by burning a fuel, a common expedient being to employ paraffin wax and a wick which is lighted and forms a lamp or burner, the heat evolved being transmitted to the solid formaldehyde through the walls of a metal container in which the formaldehyde is placed, this container being positioned above the burning wick. When a solution of formaldehyde and water is used and is treated with potassium permanganate to dissociate the formaldehyde, the gas evolved is not formaldehyde in a gaseous form but is formic acid as is shown by the following equation:

$$2CH_2O+2KMnO_4=2CH_2O_2+K_2MnO_4+MnO_2.$$

(2Formaldehyde+2 Potassium permanganate=2Formic acid+Potassium manganate+Manganese dioxid).

Such crude methods of using formaldehyde to generate formaldehyde gas necessitate the use of complicated and expensive apparatus or are ineffective and costly. The use of a paraffin lamp or candle or other means of supplying the external heat necessary to gasify the solid formaldehyde produces a large amount of carbon in the form of soot. The soot absorbs a large percentage of the heat generated and thereby prevents the complete liberation of the formaldehyde gas, while the flame of the open burner or lamp, which is always employed, creates the ever present danger of fire.

One object of my invention is to provide a compound of improved composition which is adapted for use in evolving formaldehyde gas in disinfecting and fumigating or deodorizing, in which the necessity of using external heat is overcome and rendered unnecessary and the use of a naked lamp is avoided.

Another object of the invention is to provide a mixture of chemicals with formaldehyde by which the formaldehyde in the compound is volatilized and diffused as formaldehyde gas by the reaction set up in the mixture.

Still further objects of my invention will become apparent as the invention is more fully described hereinafter and is particularly pointed out in the appended claims.

Referring now to the drawings forming part of this specification, Figure 1 is a sectional elevation of a container filled with my improved formaldehyde compound and forming a package, with the chemicals arranged therein for use in accordance with my invention. Fig. 2 is a sectional elevation similar to that in Fig. 1, showing the container with its cover removed and the package in readiness for use, in vaporizing the formaldehyde compound therein. Fig. 3 is a sectional plan, on the line III—III of Fig. 1, showing the construction of the foraminous and permeable disks used in providing the diaphragm separating the chemicals employed in causing the reaction to provide the heat necessary to volatilize the formaldehyde in my improved compound. Fig. 4 is a detail sectional elevation showing a modification in the construction of the container.

In the accompanying drawings, the numeral 2 designates a carton or container, formed of a suitable material, and conveniently and cheaply formed of tin plate. The bottom of the container is filled with a mixture 3 of powdered formaldehyde (CH_2O) and potassium persulfate ($K_2S_2O_8$) or sodium persulfate ($Na_2S_2O_8$). In preparing this mixture I preferably use the following proportions by weight:

	Parts.
Formaldehyde (pulverized)	2.5
Potassium persulfate or sodium persulfate	2.38

On top of this layer of the mixture of formaldehyde and potassium persulfate or sodium persulfate, a foraminous disk 4 preferably formed of metal is placed, the periphery of this disk resting upon the inturned bead 5 which is provided for that purpose in the side wall of the container 2. Instead of using a flat disk 4, a box 4^a having side walls and having a foraminous bot-

tom, like that shown in Fig. 4, may be employed. A sheet 6 of filter paper, blotting paper, cloth or fabric which is absorbent or permeable is placed upon the disk 4 or when the box 4^a is used, on the bottom of this box. A quantity 7 of sodium hydroxid (NaOH) or potassium hydroxid (KOH), one part or more by weight, is then placed on top of the permeable disk 6, the container being intentionally made of such size that the amount of sodium hydroxid used is not sufficient to entirely fill the container, for a purpose to be explained later. The flanged lid or cover 8 of the container is then put in place, the top 9 of this lid being indented or dished so that its inner surface will project into the box or container 2 into close contact with the sodium or potassium hydroxid forming the top layer of chemicals in the compound and hold the mixture or compound in place therein.

When packaged as has been described, with the flange 10 of the lid 8 in tight frictional engagement with the side of the box or container 2, my improved compound is in readiness for use and also can be shipped and stored for an indefinite time, until required for use in disinfecting, fumigating or deodorizing buildings, rooms, clothing or other articles or localities.

When it is desired to use a package of my improved compound, the lid 9 is removed from the box 2. A quantity 11 of water, two parts or more by weight, is then poured into the container so as to cover the sodium or potassium hydroxid, this being made possible by the height of the side of the box above the level of the top surface of the layer of hydroxid.

After the water is poured on top of the contents of the box or container 2, it percolates through and dissolves the sodium hydroxid 7, and the so formed solution after passing through the disk 6 of paper or fabric and the apertures or holes in the foraminous disk 4 comes into contact with the mixture 3 of formaldehyde and potassium persulfate or sodium persulfate in the bottom of the container 2 beneath the disks or diaphragms 5 and 6. After a saturated solution of sodium hydroxid is formed, the formaldehyde containing mixture in the bottom of the container 2 is attacked. In this process of forming the solution, heat is generated and by the reaction of the solution on the formaldehyde compound, added heat is generated, the combined heat being more than sufficient to sustain or keep up the chemical reaction. The formaldehyde is thereby decomposed and combines with the sodium or potassium in the hydroxid used, forming sodium carbonate or potassium carbonate and evolving hydrogen. At the same time the potassium persulfate is decomposed, potassium sulfate is formed, the oxygen is liberated and the oxygen evolved oxydizes the hydrogen given off, sulfuric acid being formed also. The chemical reaction taking place is illustrated by the following partial and complete equations:

$$(a)\ \overline{H.HCO} + 2NaOH = Na_2CO_3 + 2H_2.$$
(a) (Formaldehyde + 2Sodium hydroxid = Sodium carbonate + 2Hydrogen$_2$).

$$(b)\ 2K_2S_2O_8 + 2H_2O = 2K_2SO_4 + O_2.$$
(b) (2Potassium persulfate + 2Water = 2Potassium sulfate + Oxygen$_2$).

$$(c)\ 2H_2 + O_2 = 2H_2O.$$
(c) (2Hydrogen$_2$ + Oxygen$_2$ + 2Water).

$$(d)\ CH_2O + 2NaOH + 2H_2O + 2K_2S_2O_8 = 2K_2SO_4 + Na_2CO_3 + 2H_2SO_4 + 2H_2O.$$
(d) (Formaldehyde + 2Sodium hydroxid + 2Water + 2Potassium persulfate = 2Potassium sulfate + Sodium carbonate + 2Sulfuric acid + 2Water).

From the above equations it is apparent that no formaldehyde gas is liberated, but when, as in my improved compound, an excess of formaldehyde is present, under the influence of the heat generated by the reaction and in the presence of the sulfuric acid formed in the reaction, which converts the formaldehyde into trioxy methylene $(CH_2O)_3$ this excess formaldehyde will be converted into gaseous formaldehyde as is shown by the following equation:

$$2K_2S_2O_8 + 2H_2O + 2NaOH + CH_2O + CH_2O = 2K_2SO_4 + Na_2CO_3 + 2H_2SO_4 + 2H_2O + CH_2O.$$
(2Potassium persulfate + 2Water + 2Sodium hydroxid + Formaldehyde + Formaldehyde = 2Potassium sulfate + Sodium carbonate + 2Sulfuric acid + 2Water + Formaldehyde).

The combination of chemicals above given on account of their relative cheapness and for other reasons is preferred, although any other combination which generates sufficient hydrogen to take up the evolved oxygen, (combining with it to form water), and in this way preventing the oxidation of the formaldehyde to formic acid, can be substituted, as for example:

$$(I)\ \overline{H.HCO} + 2NaOH = Na_2CO_3 + 2H_2.$$
(I) (Formaldehyde + 2Sodium hydroxid = Sodium carbonate + 2Hydrogen).

$$(II)\ 2CH_2O + 2KMnO_4 = 2CH_2O + O_2 + K_2MnO_4 + MnO_2.$$
(II) (2Formaldehyde + 2Potassium permanganate = 2Formaldehyde + Oxygen$_2$ + Potassium manganate + Manganese dioxid).

$$(III)\ 2H_2 + O_2 + 2CH_2O = 2H_2O + 2CH_2O.$$
(III) 2Hydrogen$_2$ + Oxygen$_2$ + 2Formaldehyde = 2Water + 2Formaldehyde).

(IV) The complete reaction is shown by the equation:

$$3CH_2O + 2NaOH + 2KMnO_4 = Na_2CO_3 + K_2MnO_4 + MnO_2 + 2H_2O + 2CH_2O$$
or (3Formaldehyde + 2Sodium hydroxid + 2Potassium permanganate = Sodium carbonate + Potassium manganate + Manganese dioxid + 2Water + 2Formaldehyde).

This latter compound leaves a muddy black residue, not present in the case of the first given reaction, so that for this reason the last compound is not as desirable as the first.

The mixture for formaldehyde and persulfate may be made into a paste and also the sodium or potassium hydroxid or when found desirable a solution of formaldehyde and persulfate and a saturated solution of sodium or potassium hydroxid may be used, which when mixed will cause the reaction and provide the heat necessary to volatilize the formaldehyde.

The advantages of my invention will be appreciated by those skilled in the art. By the use of my improved compound or its equivalent, the use and necessity of an open lamp having a naked flame is avoided and overcome and the danger of fire is prevented. The formaldehyde is readily volatilized or gasified and the disinfecting, fumigating or deodorizing operation is easily carried out by any one so that lack of skill in handling the packaged compound will not prevent its effective use. By packaging the materials in the manner disclosed and claimed, the compound can be shipped and stored in readiness for use at any time.

Changes in the ingredients and the proportions thereof may be made, as has been pointed out, without departing from my invention. Instead of packaging the mixture of formaldehyde and potassium or sodium persulfate with the sodium hydroxid, the sodium hydroxid may be kept separate therefrom, and when used may be mixed with water to form a saturated solution which is poured upon the formaldehyde containing mixture to promote the reaction and obtain the heat necessary to liberate the gaseous formaldehyde.

The hydroxids of the chemicals used may be replaced by the oxids or peroxids thereof. Any hydroxyl forming alkali metal may be used with the mixture of formaldehyde and persulfate in causing the reaction and various other changes may be made within the scope of the appended claims.

I claim:—

1. The method of generating pure formaldehyde gas without oxidation of formaldehyde and evolution of formic acid, which consists in reacting upon a mixture of paraformaldehyde and a persulfate, with a hydroxyl forming alkali metal.

2. The method of generating pure formaldehyde gas without oxidation of formaldehyde and evolution of formic acid, which consists in reacting with a solution of a hydroxyl forming alkali metal upon a mixture of substantially equal parts of paraformaldehyde and a persulfate.

3. The method of generating pure formaldehyde gas without oxidation of formaldehyde and evolution of formic acid which consists in reacting with a saturated solution of a hydroxyl forming alkali metal upon a mixture of paraformaldehyde and a persulfate.

4. The method of generating pure formaldehyde gas without oxidation of formaldehyde and evolution of formic acid which consists in reacting with a solution of sodium hydroxid upon a mixture of paraformaldehyde and potassium or sodium persulfate.

5. The method of generating pure formaldehyde gas without oxidation of formaldehyde and evolution of formic acid which consists in reacting with a solution of sodium hydroxid upon a mixture of substantially equal parts of paraformaldehyde and potassium or sodium persulfate.

In testimony whereof, I have hereunto set my hand.

HENRY ANHALTZER.

Witnesses:
WILLIAM B. WHARTON,
R. D. LITTLE.