March 10, 1936. E. SILTEN 2,033,489

APPARATUS FOR GENERATING VAPORS

Filed Feb. 16, 1933 3 Sheets-Sheet 1

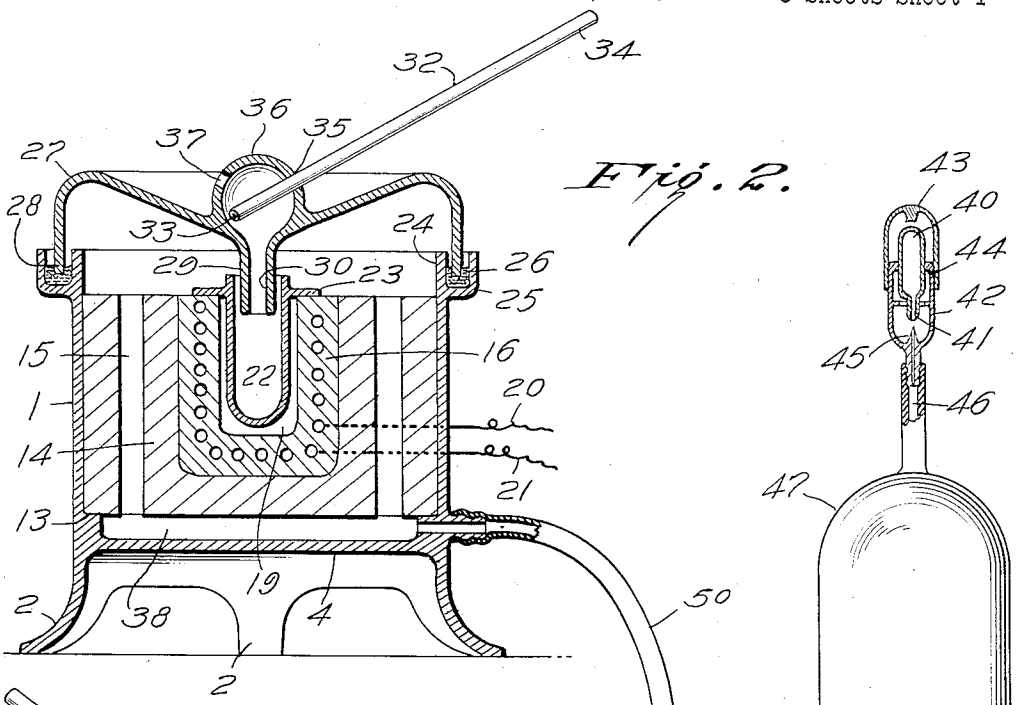


Fig. 2.

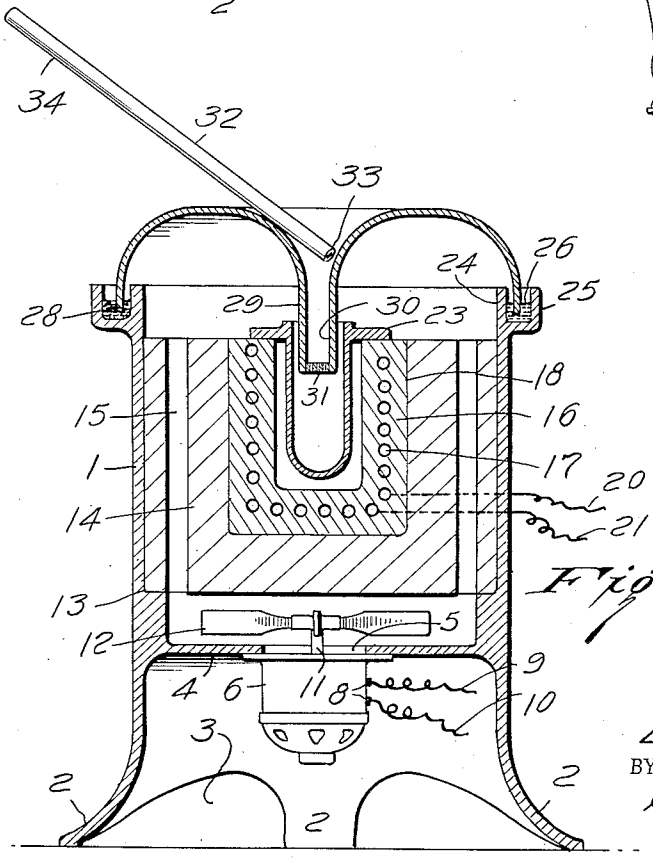


Fig. 1.

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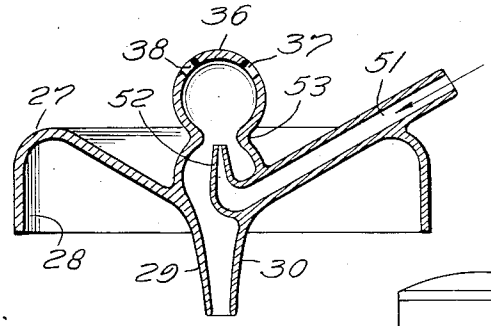


Fig. 3.

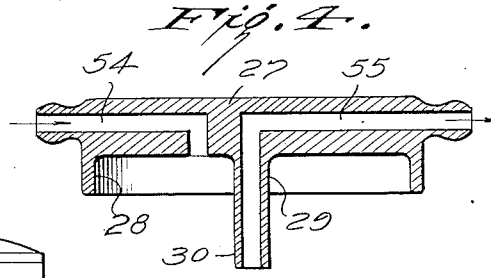


Fig. 4.

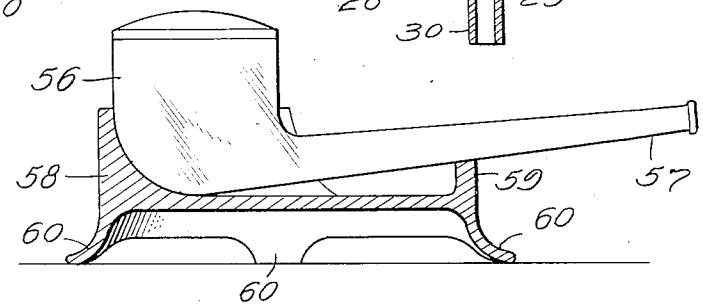


Fig. 5.

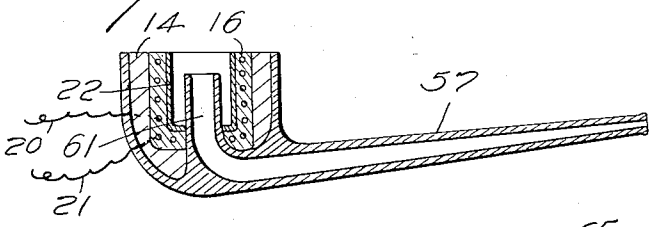


Fig. 6.

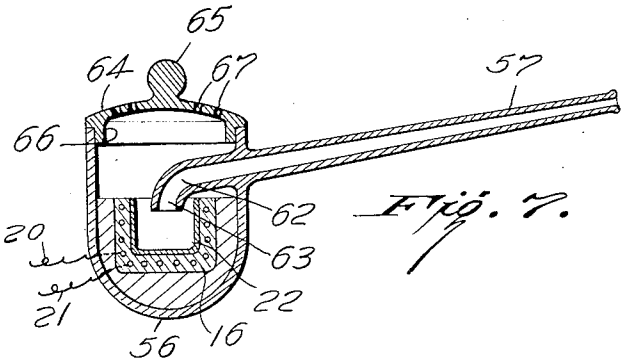


Fig. 7.

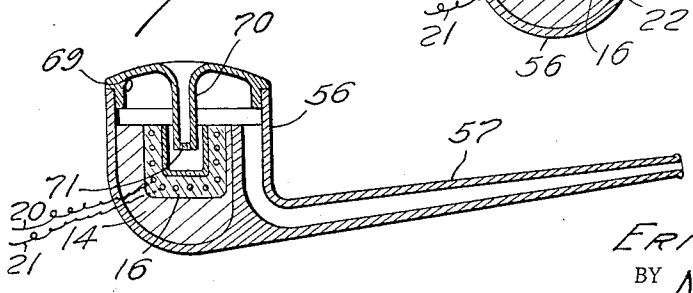


Fig. 8.

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APPARATUS FOR GENERATING VAPORS

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Fig. 9.

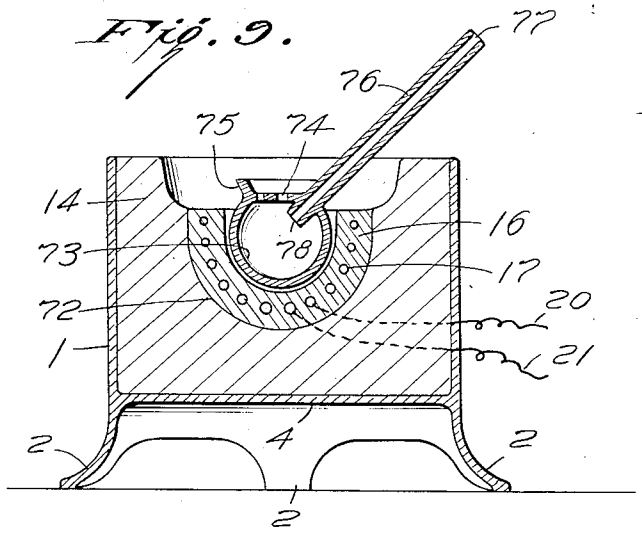


Fig. 10.

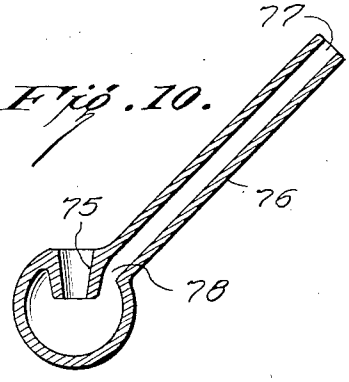
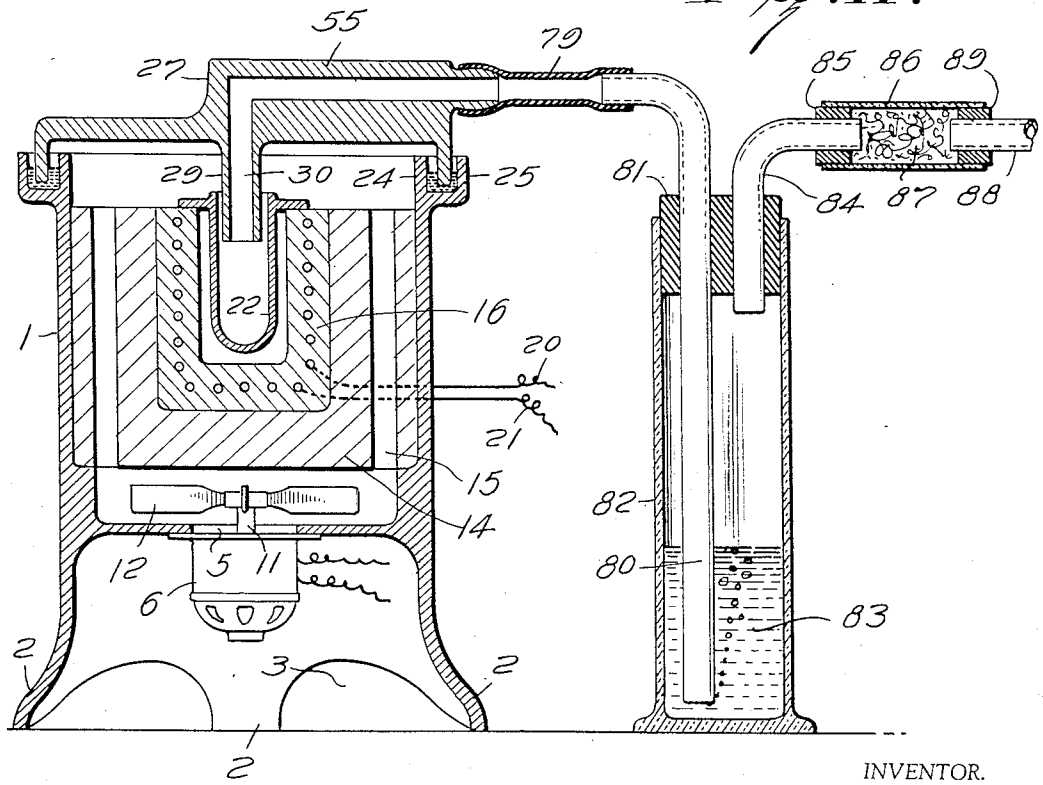


Fig. 11.



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UNITED STATES PATENT OFFICE

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APPARATUS FOR GENERATING VAPORS

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Application February 16, 1933, Serial No. 657,073
In Germany February 25, 1932

8 Claims. (Cl. 219—38)

This invention relates to apparatus for and to a method of vaporizing substances, with or without chemical reactions, for various purposes. More particularly the invention is adapted for industrial and technical applications and for inhalation for the treatment of diseases of the respiratory organs.

In one aspect of this invention, it comprises an inhalation device embodying an electric heater or oven adapted to vaporize metals, compounds thereof, salts and other substances for chemical, medical, hygienic and other purposes. In such a device the various substances, such as metals or salts, are heated to such temperatures that they may melt and they are held at such temperatures that they vaporize.

The vaporized substances are withdrawn from the device and utilized as desired. For the treatment of the respiratory organs there is provided a tube or other means held in the patient's mouth whereby the vapors may be led into the mouth or inhaled by the patient. The vapors may be pure or may be mixed with air or other gases, or with vapors of other substances, depending on the purpose of the operation.

In practicing this invention it is desirable to maintain the temperature of the oven substantially constant so that the physical and chemical properties of the vaporized substances and their therapeutic effects may be preserved. By such temperature control the dosage may be varied and controlled. Suitable means for temperature regulation is well known and may be applied to the oven in various ways.

The invention includes such an arrangement as to allow bringing into the oven desired gases, such for example, as facilitate or hinder dissociation, depending on whether dissociation is desired or not.

One may vaporize various substances of the following character: Bismuth and its salts, calcium chloride, salts of magnesium, salts of lithium, boron compounds, sodium chloride, metal halides, and high boiling organic compounds, such as dyes. These are merely a few examples of the substances adapted for use in the present invention. Under other conditions than are here contemplated most of the salts are decomposed either partially or wholly, upon being heated and are therefore incapable of being inhaled. The present invention provides a procedure which makes it possible to inhale such substances.

For medical purposes the following may be considered as instances where the present invention is applicable: Inhalation, laving of body cavities, and filling of body cavities such as fistulas with such substances. It may be applied for disinfection or healing, and also to produce contrasting images in X-ray pictures. Such vapors are applicable to treatment of eye and skin diseases and to mucous membrances. For hygienic purposes it may be applied to deodorization of rooms, disinfection, improvement of air in work rooms and others.

It is well known that inhalations, baths or the like are practically worthless unless they are taken daily or oftener. Up to now there has not been available any devices for these purposes because such devices are so costly and so complicated in their application, that they could be used only in medical centers or institutes. It has been found practically impossible to successfully treat patients unless they are kept in the institute for a length of time. This is in most cases not afforded because the patients are seldom bedridden or unable to carry on their work. As the result of this invention such devices have been so simplified that a small, cheap and simple apparatus is provided which the patient may use in his own home, safely and effectively.

Heretofore, in apparatus of this character, in order to produce air pressure, there were used piston pumps which were connected to the apparatus by pipes. This invention utilizes for this purpose simple arrangements, such as ducts, fan blades, rubber balls with double openings, air bulbs compressed gases in small steel cylinders or chemically evolved gases. I may also use a stream of heated air or gas passing through openings in the oven to drive out the vapors evolved therein. The oven may also be so constructed that the evolved vapors may be sucked out.

In the accompanying drawings constituting a part hereof and in which like reference characters indicate like parts,—

Fig. 1 is a vertical cross-sectional view of one form of the device, some parts being shown in elevation.

Fig. 2 is a similar view of a modified form of my device showing a different arrangement for the gas flow.

Fig. 3 is a vertical cross-sectional view of a modified form of cover.

Fig. 4 is a similar view of still another modified form of cover.

Fig. 5 is a view partially in perspective of a pipe-like form of the device and its support.

Figs. 6, 7 and 8 are vertical cross-sectional views of several modifications of the pipe-like form of device.

Fig. 9 is a similar view of a modified form which may be considered as a combination of two types of devices.

Fig. 10 is a view of a slight modification of the crucible construction, and

Fig. 11 is a vertical cross-sectional view showing purifying equipment in conjunction with the oven.

The device consists essentially of a cylindrical casing 1 of suitable material such as metal, having feet 2 so spaced as to give openings 3 therebetween. A flange 4 at the lower portion of the body 1 has a central opening 5 and a motor 6 having a flange 7 is secured to the under side thereof. Leads 8 from the motor terminate in connections 9 and 10 to a source of electrical energy. The motor shaft 11 has a fan 12 secured thereto, the fan being above the flange or plate 4.

The body 1 is provided with a seat 13 on which a body 14 of heat insulating material rests and is held. The insulating material has a series of openings 15 allowing flow of gases from the fan to the upper portion of the apparatus. In a ceramic or other mass 16 is embedded resistance wire 17, the whole being fitted into the insulating material at 18. A central space 19 within the mass provides place for a crucible. Leads 20 and 21 from the resistance wire 17 are connected to a suitable source of energy. The crucible 22 may be of any desired material and has a flange 23 resting on mass 16.

At the upper end 24 of body 1 there is an annular member 25 forming a channel in which material 26 such as sand is placed to serve as a sealing medium. A cover 27 of circular shape has its lower edge 28 embedded in material 26 and it has a central depending tube 29, the lower end 30 of which is within the crucible. Perforations 31 are provided in the bottom of part 29. A tube 32 has its lower end 33 in such a position as to catch vapors from the oven and the opposite end 34 is adapted to be held in the mouth.

In operation, material to be vaporized is placed in crucible 22, the energy is put on and the resistance wire 17 is heated. Motor 6 is caused to revolve whereby air is drawn in through openings 3 passed through the motor and by the action of the fan 12 caused to pass through openings 15 where the air is preheated. The air passes between crucible 23 and tube 29 and out through openings 31, carrying with it the vapors of the material generated in the crucible. The vapors may then enter tube 32 and be thus utilized.

The openings between the feet of the housing provide sufficient space for the entrance of the necessary air. The motor is placed at the coolest part of the device and is not detrimentally affected by the heat of the oven, particularly as fresh cold air passes over the motor before entering the apparatus. The cold air also keeps the bottom of the oven cool, making it unnecessary to utilize special insulation to protect the bottom plate against heat. The air passing through the canals becomes preheated before entering the crucible. Since there is a greater pressure in the oven than in the crucible, the passage of vapors from the crucible into the oven is prevented, thus avoiding undesirable chemical actions or other disturbing influences.

The general arrangement is the same as in Fig. 1 except that the cover 27 is of somewhat different construction. The tube 32 passes through opening 35 in dome 36 and an additional opening 37 therein may be provided. Beneath the insulation 14 is a space 38 provided by the plate 4 which in this case has no opening. A tubular extension 39 communicates with the outside. A small metal cylinder 40 containing compressed gases has a sealed end 41. This is contained within a chamber formed by parts 42 and 43 which may be caused to approach each other by cooperating threads 44. A needle opening 45 on part 42 is adapted to penetrate the end 41. Said needle opening communicates with passage 46 in chamber 47 which may be either rigid or elastic, from the opposite end of which a tube 48 having an adjusting valve 49 communicates with tube 50 which in turn is connected to opening 39.

By means of the arrangement shown in Fig. 2, it becomes possible to use any desired gas to drive out the vapors from the crucible. The application of these gases may be made from various viewpoints. For instance, one may apply nitrogen for chemical reasons. In a nitrogen atmosphere oxidation is inhibited and dissociation is lessened. For therapeutic purposes carbon dioxide may be applied, it serving to stimulate and deepen breathing, and it thereby causes a deeper penetration of the desired vapors into the lungs. It is especially useful in the treatment of tuberculosis by the deep inhalation of sodium chloride vapors.

In many cases it is desirable to mix the gases with the vapors outside of the crucible, because at the high temperature of the oven reactions may take place causing decomposition or other change, which are not desired. In Fig. 3 there is shown a cover 27 in which a tube 51 is adapted for bringing in gases and it has an upwardly turned nozzle end 52 surrounded by a constricted portion 53 of the dome 36 whereby to provide an aspirator to draw out vapors from the crucible.

In Fig. 4 there is shown a modification of the cover which allows the introduction of gases without preheating the same. It includes an opening 54 allowing gases to pass into the dome and over the vapors and then into the tube 29 and out through tube 55. In this case the bottom of the oven structure is closed in such a manner that no air can pass through the same.

If the vapors from the crucible are to be directly inhaled by the patient, then one may provide a very simple embodiment of the invention by making the device in the form of a pipe. Such an arrangement has a number of advantages in that it is natural for pipe smokers to use, it is unitary in construction and is easy to handle. This type of device is susceptible of many variations and several such forms are illustrated in Figs. 5 to 8 inclusive.

The bowl 56 of the pipe has a stem 57 to be held in the mouth. The holder consists of a part 58 on which the bowl may rest and a part 59 on which the stem may rest. Feet 60 hold the pipe above the surface and prevent heat from injuring said surface.

In Fig. 6 the arrangement is quite clear and the stem 57 passes through the bottom of part 16, the end 61 thereof being a considerable distance above the bottom of crucible 22. While a cover thereon is not shown, one may be provided.

In Fig. 7 the stem 57 has an extension 62 with the lower end 63 thereof extending somewhat into the crucible 22. The cover 64 has a handle 65 and a flange 66 to cause it to fit within the bowl 56. Openings 67 allow air or other gas to be drawn into the device.

In Fig. 8 a form of device similar to Figs. 1 and 2 is shown, the cover thereof having an in-

ner flange 69, a depending tube 70 and openings 71 therein.

In Fig. 9 there is shown a combination of an oven in which the ceramic mass 16 is curved as shown at 72 and the crucible is of similar shape as shown at 73. It has openings 74 for the introduction of air and a flange 75 forming a funnel shaped member whereby materials may be introduced into the crucible. The tube 76, the free end of which 77 is held in the mouth, has the opposite end 78 integrally formed with the crucible 73. In Fig. 10 there is a modification in which the free end 78 does not extend into the crucible itself.

The most varied materials may be vaporized in the ovens described above, and they may be applied for various purposes. As above stated, various vapors or gases as they leave the oven are not in a condition to be inhaled. The alkali chlorides present no particular difficulties, but, on the other hand, such substances as the iodides of the alkali metals upon being heated to a temperature above their melting points give off so much iodine that odor of the vapors is very pungent and it cannot be inhaled.

Another group of salts, which alone may be vaporized without decomposition, are not adapted for inhalation because the vapors in concentrated form are toxic. Dilution by mixing with other salts does not in most cases give the desired results because the boiling points are too far apart and the toxic salts vaporize alone before the other inert salts melt. Of particular interest are the halide of the metals of the fifth group of the periodic system, of which especially the salts of bismuth are valuable as therapeutic agents. For instance, bismuth chloride, which is toxic in concentrated condition but is on the contrary therapeutically valuable, boils at 447° C. A mixture thereof with sodium chloride is of no value because sodium chloride melts at about 800° C.

In order to obviate these difficulties, the process may be so operated that the undesirable decomposition products are removed or so that they are not formed. The desired vapors may be obtained from various combinations which enter into reactions either just before or during the vaporization and the desired vapors obtained in pure form. By the application of other materials into the outgoing vapors they may be diluted. This allows the use for inhalation of such diluted substances which are toxic when concentrated. If either of the methods is insufficient, a combination of dilution and purification may take place.

In order to remove decomposition products from the vapors, I may use the principle that slightly soluble substances in vapor form are but slowly dissolved by the solvent in question, as for example the vapors of phosphorus pentoxide and sulphur trioxide. The difficult solubility has its basis on the ready mobility of the vapor particles which overcomes the surface tension of the solvent. Also the vapor particles may be considered as fluid droplets which have a great surface tension and therefore resist absorption and solution. Another consideration is that solid bodies, such as charcoal, silica gel and the like, absorb such vapor particles only slowly.

These known principles are utilized to remove decomposition products from the salt vapors in a simple manner. The vapors may be bubbled through a liquid and the vaporous decomposition products washed therefrom, or the vapors may be passed through a tube filled with a granular material which combines chemically with the decomposition products or which absorbs the same, such as charcoal, silica gel, and the like. Thereby one may absorb the iodine from vapors of alkali metal iodide in potash solution or in thiosulphate. Vapors of magnesium or calcium chloride containing free chlorine may be washed with water or passed over soda lime or animal charcoal. Of course, the wash water or solutions may be replaced by other substances, such as organic liquids.

In the device of Fig. 11 the oven structure is substantially that shown in Fig. 1 with the difference that a slightly different type of cover is illustrated. The tube 55 connects by extension 79 to a tube 80 passing through a cork 81 closing vessel 82, the tube 80 terminating below the surface of liquid 83. A tube 84 connects through a cork 85 with a tube 86 containing chemical 87, and an exit tube 88 secured at the opposite end in cork 89. The functioning of this device is to purify the vapors from the oven and to render them safely usable. It is obvious that either the bubbling device or the device 86 may be omitted under certain conditions or the positions thereof may be reversed as desired.

The salts may be formed either just before or during the vaporization from other compounds. In accomplishing this a metal compound whose cation is in a non-volatile combination (for instance, as an oxide) is mixed with another salt (for instance, a chloride) with which it may exchange anions and the mixture is heated above the melting point to cause a reaction. By double decomposition the desired salt is obtained. For example, by heating a mixture of magnesium oxide with calcium chloride to 900° C. or over, a salt vapor is obtained containing an appreciable amount of magnesium chloride which is pure and can be inhaled. If on the other hand magnesium chloride is vaporized, there is formed in the air some oxychlorid, the vapors of which are very pungent.

As another example, it is possible to take a salt which is toxic in concentrated form and produce a diluted vapor adaptable for therapeutic use with the vapor of another salt. For instance, one melts a mixture of sodium chloride and bismuth oxide and passes a stream of air over the melt, and a reaction takes place forming sodium oxid and bismuth chloride. However, the reaction is not complete but depends on the temperature, like dissociation. There is also to a certain extent a reversion reaction. At a determined temperature there exists sodium chloride, bismuth oxid, sodium oxide and bismuth chloride. The two oxides are non-volatile so that the vapors contain only sodium and bismuth chlorides in proportions dependent on the temperature. This mixture is non-toxic and may be safely inhaled with therapeutic effects. In place of the difficultly fusible metal compounds, in many cases the metal itself may be used in place of the oxide. So the bismuth oxid may be replaced by metallic bismuth.

Although I have described my invention setting forth several specific forms of my device, the invention is not limited thereto. The operations in which my invention may be used are many more than have been set forth above. These examples indicate that the principles set forth herein may be embodied in a large variety of forms. My invention is to be considered of broad scope and to be limited only by the terms of the claims appended hereto.

What I claim is:

1. An apparatus comprising a crucible for material to be vaporized, an electric heater for vaporizing said material surrounding the same substantially completely, said heater being encased in insulating material, an exit opening for removing gases communicating with and at a point at the top of said crucible, means for allowing entrance of gases to said crucible at a point above material therein, and a conduit for removing a mixture of said gases thru said opening to the desired point.

2. An apparatus comprising a crucible for material to be vaporized, an electric heater for vaporizing said material surrounding the same substantially completely, said heater being encased in insulating material, an exit opening for removing gases communicating with and at a point at the top of said crucible, means for causing gases to pass thru said insulating material and then for allowing entrance of gases to said crucible at a point above material therein, and a conduit for removing a mixture of said gases thru said opening to the desired point.

3. An apparatus comprising a crucible for material to be vaporized, an electric heater for vaporizing said material surrounding the same substantially completely, said heater being encased in insulating material, an exit opening for removing gases communicating with and at a point at the top of said crucible, means for allowing entrance of gases to said crucible at a point above material therein, a removable cover over said crucible and heater and insulating material, and a conduit for removing a mixture of said gases thru said opening to the desired point.

4. An apparatus comprising a crucible for material to be vaporized, an electric heater for vaporizing said material surrounding the same substantially completely, said heater being encased in insulating material, a casing around said insulating material, an exit opening for removing gases communicating with and at a point at the top of said crucible, means for allowing entrance of gases to said crucible at a point above material therein, and a conduit for removing a mixture of said gases thru said opening to the desired point.

5. An apparatus comprising a crucible for material to be vaporized, an electric heater for vaporizing said material surrounding the same substantially completely, said heater being encased in insulating material, a casing around said insulating material, an exit opening for removing gases communicating with and at a point at the top of said crucible, means for allowing entrance of gases to said crucible at a point above material therein, and a conduit for removing a mixture of said gases thru said opening to the desired point, said casing being integral with said conduit.

6. An apparatus comprising a crucible for material to be vaporized, an electric heater for vaporizing said material surrounding the same substantially completely, said heater being encased in insulating material, a casing around said insulating material, an exit opening for removing gases communicating with and at a point at the top of said crucible, means for allowing entrance of gases to said crucible at a point above material therein, and a conduit for removing a mixture of said gases thru said opening to the desired point, said casing and conduit being in the form of a smoker's pipe.

7. An apparatus comprising a crucible for material to be vaporized, an electric heater for vaporizing said material surrounding the same substantially completely, said heater being encased in insulating material, an exit opening for removing gases communicating with and at a point at the top of said crucible, means for allowing entrance of gases to said crucible at a point above material therein, means for purifying said mixture of gases, and a conduit for removing a mixture of said gases thru said opening to the desired point.

8. An apparatus comprising a crucible for material to be vaporized, an electric heater for vaporizing said material surrounding the same substantially completely, said heater being encased in insulating material, an exit opening for removing gases communicating with and at a point at the top of said crucible, means for allowing entrance of gases to said crucible at a point above material therein, and a conduit for removing a mixture of said gases thru said opening to the desired point, the pressure of said gases being sufficiently greater than the pressure of said mixture of gases in said conduit to cause a flow thereof.

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