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LABORATORY APPARATUS FOR THE CONTROL OF VAPORS

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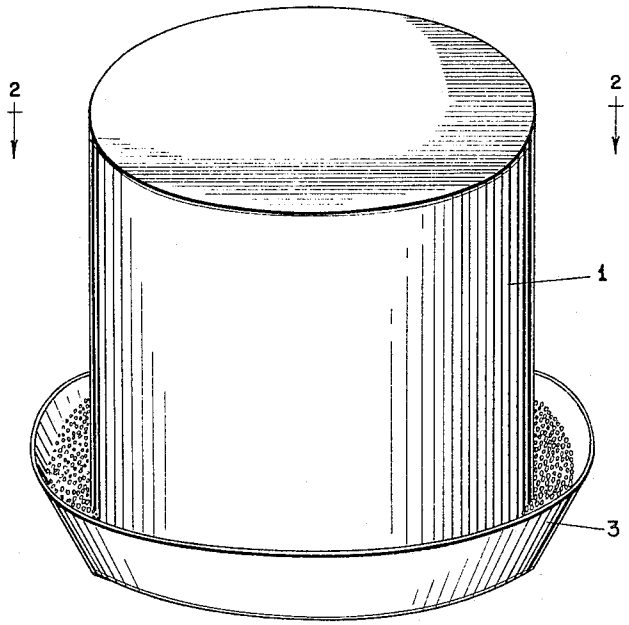


FIG. 1

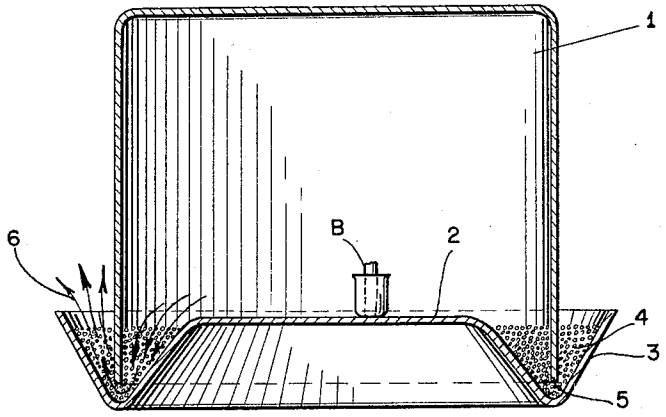


FIG. 2

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LABORATORY APPARATUS FOR THE CONTROL OF VAPORS

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This invention relates to laboratory apparatus, relatively inexpensive, for the control of moisture and other vapors. It relates more particularly to an apparatus of two structural units or parts forming a chamber, which parts are employed in conjunction with a subdivided solid in the region where the said units almost meet or touch. It relates to an inexpensive apparatus of the type just described that can serve as a superbly performing desiccator for students, particularly in chemistry. It also relates to a relatively inexpensive apparatus, in which bottles or the equivalent of chemicals may be stored without release of obnoxious or corrosive vapors or fumes, or even of highly fragrant odors, to the outside space, i.e. the space where such apparatus is kept. With this apparatus the space in the interior thereof is inherently maintained at substantially atmospheric pressure at all times.

The ordinary laboratory desiccator consists of a glass or metal cover with, below it, a mating glass or metal structure or part with the closure being usually a leak-proof lubricated ground glass or metal seal; this lower vessel is relatively quite deep and in the bottom of the same the dehydrating substance, solid or liquid, is placed and above this is the plate upon which the material to be desiccated is placed. Some of the larger and more expensive desiccators have a tube of glass with a stop-cock thereon for drawing a vacuum within the chamber. A disadvantage of such desiccators is that they are expensive. Also many of them are somewhat too bulky for routine use by students in chemistry in the secondary schools or even in colleges for laboratory work of the students in first year general chemistry or organic chemistry. Also, in the use of such desiccators, the development of a partial vacuum or a supra-atmospheric pressure within the desiccator, produced by fluctuation of temperature or vapor content of the matter to be dried, may give rise to problems, such as the difficulty of removal of the cover or spillage of material from in-rushing air.

It is, therefore, an object of the present invention to provide an inexpensive desiccator, the structural parts of which can be stacked completely and whose two structural parts are rather inexpensive.

Many laboratories store chemicals that release obnoxious fumes or vapors. Such fumes or vapors may be odorous, some very obnoxious, or corrosive. Slight leaks in ordinary bottle tops or closures, or traces of chemicals that adhere to the threads or to the sides of the bottles, or leakage from opened ampules may be highly objectionable. This is evidenced by the fact that laboratories that store odorous chemicals (e.g., mercaptans, amines, and the like chemicals that are characterized by stenches, or more pleasant odoriferous materials like essential oils, perfume intermediates and the like) are generally highly odorous, attributable to the combined effects of such leakages. Laboratories that store volatile corrosive chemicals (e.g. bromine, chlorsulfonic acid, hydrochloric acid and the like) find that corrosion of scientific instruments and laboratory equipment is accelerated by the combined effect of such leakages. Some laboratories store such odorous or corrosive materials in special stench rooms, corrosive-proof storage rooms or under hoods provided with continuous ventilation; but all such expediencies are costly. There have been attempts at designing leak-proof caps, but none is universally applicable to all types of containers or effective against films that have leaked down the sides of containers.

It is therefore another object of this invention to provide an inexpensive apparatus in which bottles or their equivalent of chemicals that release obnoxious or corrosive or strong, less offensive fumes may be stored without the release of any such fumes or vapors to the outside. It is still another object to provide apparatus which maintains substantially atmospheric pressure within the chamber formed by the two parts of the apparatus.

The present invention is an apparatus or laboratory device characterized by a cover member, preferably an inverted, U-shaped (cross-section), convex member made of glass or even of metal, more preferably of plastic, that is impervious to the atmosphere, which cover member cooperates with a base member, which is a plate that has a flat, circular-shaped central portion, merging downwardly into a circular-shaped channel; the perimeter of the plate is the outer edge of the trough. It is much preferable, for reasons brought out subsequently, for the base member to be horizontal and substantially flat except for the concave section or trough. The cover, the inverted U-shaped member, may be relatively high in elevation attributable to the sides, or it may not. It is inherent that the base member, whether a plate or a dish, be of somewhat greater overall diameter or breadth than the mating convex member (cover). The base member can be made of glass, plastic, metal, such as aluminum, but such materials as metals, particularly aluminum, are subject to corrosion. The glass can be of the heat resistant type (borosilicate) or less preferably of the non-heat resistant type. A suitable size for the cover is 6 inches across the lower edge (diameter), and the size of the cooperating base member 7 inches. But it will be understood that, whereas this is a convenient size for most students in the secondary schools and lower college years, a larger size may be preferable, such as where chemicals are stored. The cover is a hollow cylinder, having one end closed, and preferably a flat surface, but not so restricted, and the base plate correspondingly circular in shape yet of wider diameter than the cover parallel the perimeter ordinarily and its outer edge constitutes the perimeter of the base member. In this trough there is placed, for the use of the apparatus, the desiccant, adsorbent or absorbent material that is to be used for the control or removal of moisture or other objectionable gases, vapors or fumes. When the two elements of my invention, namely the impervious cover and base members are in place they provide a chamber. On the flat circular-shaped central area of the plate or dish there is conveniently placed or stored the matter to be dehydrated or from which any emanating vapor or fume is to be either removed or controlled; so, the base member serves two roles. However, a tripod or other structure, which does not constitute a part of this apparatus, having a perforated or non-perforated top surface may be placed on the flat surface of the member to hold the matter.

The unique feature of this invention is the provision of a long molecular diffusion path, made possible by the trough near the periphery of the base member, filled or approximately so with the desiccant, adsorbent or absorbent material. This path must be traversed by a gas or vapor that is transferred between the inside and the outside of the chamber. This diffusion path is through the small spaces among the packed particles of the solid and is therefore long and tortuous. This long diffusion path referred to in the first sentence of this paragraph provides ample opportunity for molecules of moisture or other vapor or fume to make contact with the particles of solid referred to supra; in this way complete control or removal of water or other fume or vapor i

achieved. However, no hermetic seal is effected, and as a result the pressure inside the chamber is substantially atmospheric. It will be understood that if a hot vessel, or object to be treated, or both, is placed inside the chamber, and the edge of the cover thereof properly adjusted in the pulverized material in the trough of the base member, that air from the outside will be drawn slowly inside of the chamber upon cooling of the contents to room temperature. This does away with the formation of a partial vacuum or onrushing air, two of the objections to the use of the conventional desiccators which have been referred to supra.

The base portion of the conventional desiccators used in chemical laboratories is rather deep in design or structure, making provision for the pulverized or liquid desiccant, etc., and above that for the positioning of a flat plate for replacement of the material to be treated. In the present invention, in contrast, the base plate or dish is substantially flat, except for the trough-shaped circular portion near its perimeter. So a multiplicity of these plates or dishes can be compactly stacked, especially the plates, particularly so when they are of the same diameter and trough configuration, and made of non-breakable solid plastic, such as the polyethylene type. The amount of space taken by these plates of the applicant's invention is small as compared with the space that would be taken up by the same number of conventional bases which are several inches in height, i.e. bases of the conventional desiccators.

The gas adsorbent which may be employed in the present invention may comprise such adsorbents as anhydrous calcium chloride (for water vapor), various activated carbons, aluminum oxide gels, silica gels, manganese dioxide, finely divided metals, such as zinc, nickel, platinum and the like which may function as adsorbents, absorbents, also other adsorbents or absorbents, or mixtures thereof, of which there are many known in the art. For an acid adsorbent, zinc oxide may be used. The activated carbons may be any of the charcoals produced by destructive distillation of vegetable matter, with or without the conventional addition of chemicals, and characterized by rapid effective adsorption.

My invention is on an apparatus, particularly for use by undergraduate and/or high school students. The gas adsorbent forms no part of my invention as has been mentioned. Various solid adsorbents have been mentioned, the selection depending upon the use to which the apparatus will be put. Liquids instead of solids could be used, but for students of those educational levels is not desirable or indeed not preferable. For liquid dehydrating agent, concentrated sulfuric acid or glycol or glycerine may be employed.

For a better understanding of this invention, reference is now made to the accompanying drawing, in which similar numerals indicate like parts.

FIGURE 1 is a perspective view of the apparatus, with granular material in the trough of the plate thereof.

FIGURE 2 is a vertical section taken along line 2—2 of FIGURE 1, i.e. as the diameter line.

The cover in the embodiment which is shown in FIGURES 1 and 2, which cover bears the numeral 1, is made of glass, preferably a boro-silicate glass, since this type is heat resistant and also resistant to acids and inorganic gases, or more preferably made of a plastic having similar characteristics. Glass is preferable to metal generally. That portion extending beyond the horizontal, flat area thereof, it will be noted, has a trough or channel, numbered 3, near the perimeter of the plate. Otherwise the plate is flat in construction. On this flat, circular-shaped central portion there is shown a small beaker, in which there is an opened ampoule which bears the letter B, which beaker and ampoule form no part of the present invention, whatsoever, and in which ampoule there is a substance being treated or observed. In the channel or trough 3 there is a granular material, which is numbered 4; this covers the lower edge 5 of the cover 1 almost the entire depth of the channel. Thus, the lower edge 5 of the cover 1 is caused to be embedded in the granular material a substantial depth, but leaving a space between the very edge of the cover and the upper surface of the bottom of the trough. The numeral 6 is placed in the drawing to indicate the long molecular diffusion path that any gas or vapor must travel between the inside and the outside of the chamber. This is a distinctive or unique feature of the present invention.

In the embodiment shown in the drawing as FIGS. 1 and 2, the cover is cylindrical in shape and is impervious. The plate or dish is likewise impervious. The plate has a flat, circular-shaped central portion which merges downwardly, thereby forming a circular-shaped channel, which extends outwardly beyond the said flat area. The bottom of the channel matches the outside diameter of the cover, and is suitable for containing solids for the control of vapors within the chamber formed by the said cover and plate. As seen from FIG. 2, the cover 1 is not physically attached to the plate 2. They are incapable of touching one another in assembled position except when the edge of the cover fits into the channel of the plate, the latter holding the granular material, such as a dessicant, when in use.

Examples, showing the operation of the present invention will now be presented.

EXAMPLE 1

A wet crystal cake of acetamide is placed on a piece of filter paper, and placed on plate 2. And granular, anhydrous calcium chloride ($CaCl_2$) is placed, if it has not already been placed, in the circular trough or channel 3 of this plate. Then the cover 1, whicb is an inverted, impermeable, heat resistant glass cylindrical shaped unit, is pushed down in the concavity, so that its rim is within the bed of the granular desiccant. The acetamide crystal cake dries readily to a dry powder. It will be observed, particularly from FIGURE 2 of the drawing, that there is a good exposure of the granular, anhydrous calcium chloride within the chamber, which is responsible for the dehydration action of the acetamide.

EXAMPLE 2

In this example an ampoule of bromine, which ampoule has been previously opened, and the bromine therein partly used, has been closed with a cork. But the ampoule nevertheless leaks bromine as evidenced by odor of bromine near the cork and by the accelerated corrosion of nearby equipment.

The ampoule is placed on the flat surface of plate 2. The channel or trough 3 is filled with granular (6–14 mesh) activated carbon of the type customarily used for air purification, if it has not previously been placed in the trough. A glass battery jar is inverted and pushed partway into the activated carbon in the trough. No bromine leaks to the outside, since the vapors of bromine are adsorbed by the activated charcoal, which can hold about its own weight of bromine. The space which constitutes the chamber does not build up any bromine concentration. As a result of the condition secured, the label on the ampoule is undamaged, as inspection verifies.

EXAMPLE 3

In this example, which is quite a severe test, a bottle of amyl mercaptan (gas odorant stench) is employed, and although the bottle is closed with a screw cap, nevertheless an obnoxious odor is released.

This bottle is stored, as described for the bromine ampoule of Example 2, i.e., with activated carbon in the channel or trough. No odor can be detected outside the chamber.

Three examples have been presented above. The first of these examples illustrates the apparatus' use in dehydration of a laboratory preparation, the most common

use of a desiccator. The second of these examples illustrates the utility of the apparatus in the storage of a volatile, corrosive chemical that is harmful to human beings, namely bromine (a liquid). The third of these illustrates the utility of this apparatus for confining stench substances. This apparatus, it is obvious, affords an inexpensive, readily assembled apparatus for the student and for the secondary school or college department as a desiccator and likewise as a storage chamber, at atmospheric pressure, for corrosive and for stench chemicals. It consequently has wide applicability for all secondary schools that maintain chemical laboratories and for many colleges as well. Space can be conserved with most of the embodiments, because plates in particular take up so much less space than the conventional desiccators.

It is quite obvious that the diameter of the plate or dish will vary, depending upon the size of the cover. Both the cover and the base plate or dish must be impermeable to the atmosphere, and are preferably made of a strong, non-breakable plastic, resistant to acids and strong inorganic bases, even to halogens. Second choice are glass covers, and plates or dishes, that are heat resistant also acid and caustic resistant. The diameter of the open end of the cover measured across the rim thereof must be substantially the same as the diameter of the plate or dish measured from the bottom of the channel or trough. The diameter of the plate or dish, perimeter measurement, is slightly greater than that of the diameter of the rim measurement of the cover, i.e., comparing diameter measurements. The cross-section of the trough can be V-shaped, U-shaped, preferably V-shaped, with different angles formed by the sides and of equal or unequal lengths of the sides that make the trough. And, whereas the desiccant, adsorbent or absorbent solid is necessary for the functioning of the apparatus, the latter does not embrace the former, i.e., the pulverized solid is not a part of the apparatus of this invention.

Variations and modifications to meet the particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown in the embodiment. And I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my invention as defined in the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A laboratory apparatus for the control of vapors, characterized by (1) an impervious circular cover having an impervious cylindrically-shaped depending side wall, and (2) an impervious plate having a flat, circular-shaped central portion, the said plate being of somewhat greater outside diameter than the outside diameter of the cover, and the flat section of the plate merging downwardly, thereby forming a circular-shaped channel which extends outwardly beyond the said flat area section of the plate, the bottom of the channel matching the outside diameter of the cover, and being suitable for containing solids for controlling the vapors within the chamber formed by the said cover and plate, these two units being physically unattached to one another and not capable of touching one another in the assembled position except where the edge of the cover fits into the channel of the plate.

2. An impervious plate as set out in claim **1**, wherein the composition is an unbreakable plastic resistant to acids and bases of the inorganic type that are better known.

3. A laboratory apparatus for the control of vapors, characterized by (1) an impervious circular cover having an impervious cylindrically-shaped depending side wall, and (2) an impervious plate having a flat, circular-shaped central portion, the said plate being of somewhat greater outside diameter than the outside diameter of the cover, and the flat section of the plate merging downwardly, thereby forming a circular V-shaped channel which extends outwardly beyond the said flat section of the plate, the bottom of the channel matching the outside diameter of the cover, and being suitable for containing solids for controlling the vapors within the chamber formed by the said cover and plate, these two units being physically unattached to one another and not capable of touching one another in the assembled position except where the edge of the cover fits into the channel of the plate.

4. An impervious plate as set out in claim **3**, wherein the composition is an unbreakable plastic resistant to inorganic acids and bases of the better known types.

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