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SMOKE GENERATING TUBE

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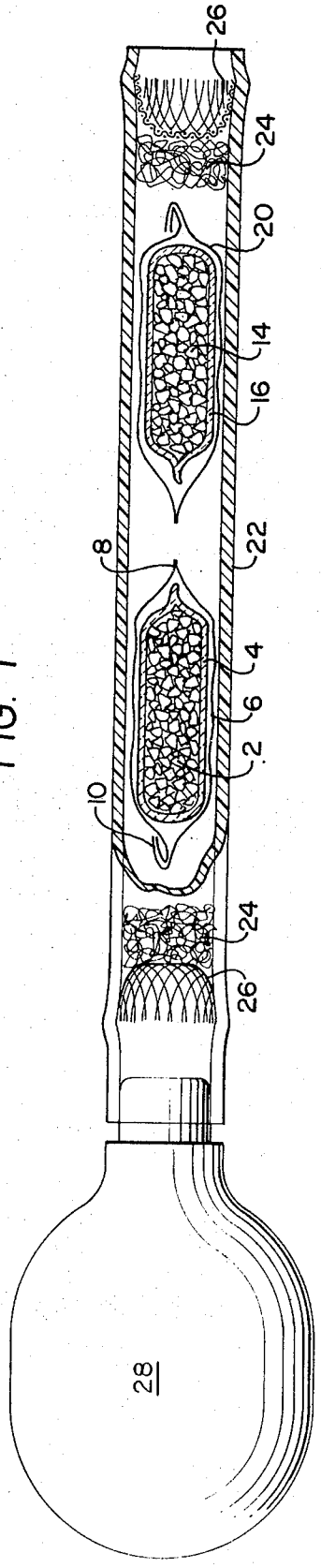


FIG. 1

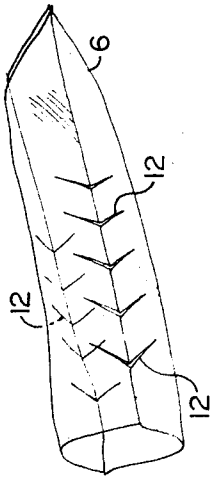


FIG. 2

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SMOKE GENERATING TUBE

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ABSTRACT OF THE DISCLOSURE

A solid acid reagent and a solid base reagent are separately contained in a breakable ampoule that is enclosed in a perforated envelope, which is in turn contained in a pliable tube. Smoke is generated by breaking the ampoules and passing air through the tube.

This invention relates to a smoke generating device and more particularly to a device in which a volatile acid and volatile base are reacted to produce a smoke of finely divided salt.

Compact, portable smoke generators are used for determining the direction and velocity of air currents as, for example, in testing heating and air-conditioning installations. A cloud of smoke is generated, its direction and time of travel over a given distance are observed. Conventional generators, commonly called ventilation smoke tubes, operate by passing air through a bed of granular absorbent impregnated with stannic chloride that reacts with moisture in the air to produce a dense smoke. The stannic chloride smoke, however, is acrid and irritating.

It is an object of this invention to provide a ventilation smoke tube in which the smoke is generated by reaction of a volatile base and a volatile acid. Another object is to provide such a tube in which the acid and base are segregated to provide a long storage life before use of the tube. Another object is to provide such a tube in which the acid and base are separated during use by a perforated barrier. Other objects will be apparent from the following description and claims.

In accordance with this invention, a solid acid reagent and a solid base reagent are contained in separate sealed, breakable ampoules, and each of the ampoules is enclosed in a perforated envelope. The solid reagents consist of a solid absorbent impregnated with a volatile acid or base. The envelopes are contained and spaced lengthwise within a pliable tube. Means is provided to force atmosphere through the tube. When the ampoules are broken, the perforated envelopes prevent intermixing of the solid reagents while the volatile components of the reagents can diffuse through the perforations in the envelope. When air is flowed through the tube, the volatile reagent components that have diffused outside the envelope react to form a dense smoke that is discharged from the tube.

In the accompanying drawings:

FIG. 1 is a side view, partly in cross-section, of a smoke tube in accordance with this invention, and

FIG. 2 is a perspective view of a perforated envelope in FIG. 1.

With reference to FIG. 1, solid reagent **2** is contained in a sealed glass ampoule **4** which in turn is enclosed in a perforated envelope **6** of polyethylene tubing heat sealed at one end **8** and folded over at the other end **10**. As best seen in FIG. 2, the envelope has a plurality of perforations **12** made as by cutting slits in the tubing wall. The perforations provide only small dimension openings so that transfer of the volatile acid portion of the reagent is substantially by diffusion; that is, there is no significant convection flow of gases through the envelope. A great variety of methods of making suitable perforations are well known, such as, for example, slitting or puncturing with needles or electrical sparks. Base reagent **14** is likewise contained in a breakable ampoule **16** enclosed in perforated envelope **20**. Both envelopes are contained in a pliable tube **22** with suitable porous retainers such as glass wool plugs **24** and screens **26**. Aspirator bulb **28** has conventional check valves to permit purging of the atmosphere through the tube.

In operation, the pliable tube is squeezed to break ampoules **4** and **16**, and aspirator bulb is squeezed to force air through tube **22**. The volatile acid component from acid reagent **2** is carried on the air stream to contact the volatile base component from base reagent **14**. The volatile components react to form a very finely divided coherent smoke that is discharged through porous retainers **24** and **26**. No smoke is generated unless air is being flowed through the tube **22**, and even after breaking the ampoules, the tube can be laid aside for one or two days and still be operative.

The acids and bases are carried on an inert solid absorbent, such as, for example, paper, porous ceramics or glass, and granular inorganic absorbents such as silica gel, alumina gel and pumice. Any liquid volatile acid may be used, for example, aqueous nitric acid, preferred acids being aqueous hydrochloric acid and glacial acetic acid. Any liquid volatile base may be used, for example, ammonium hydroxide, alkyl amines such as isopropylamine, tert-butyl amine and cyclohexylamine and ethylene diamine, and alkinolamines, such as monoethanolamine and diethanolamine.

In one illustrative example of this invention, an acid reagent of 0.5 cc. of anhydrous acetic acid on 1.0 cc. of 8–14 mesh silica gel was sealed in a glass ampoule and enclosed in a perforated envelope of 0.002" polyethylene. The base reagent of 0.3 cc. ethylenediamine on 0.7 cc. of 10–20 mesh pumice was likewise sealed in a glass ampoule and perforated polyethylene envelope. The reagent packages are enclosed in a 5-inch length of ⅜" I.D. Tygon tubing having a wire screen and Fiberglas plug adjacent each end. The tubing is connected to the aspirator bulb so that air can be pumped over the reagents. The proportions of acid and base can be varied, to give a smoke that is acid, basic, or substantially neutral. In another example, the acid reagent is 0.6 cc. concentrated hydrochloric acid on 1.2 cc. silica gel and the base reagent is 0.6 cc. concentrated ammonium hydroxide on 1.2 cc. pumice. Both tubes produced a dense coherent smoke.

I claim:

1. A smoke generating device for dispersing said smoke upon forcing air therethrough comprising a first breakable ampoule, an acid reagent contained in said ampoule consisting essentially of an inert solid absorbent impregnated with a volatile acid reactant, a first flexible perforated envelope enclosing said first ampoule and

adapted to contain the acid reagent when the ampoule is broken, a second breakable ampoule, a base reagent contained in said second ampoule consisting essentially of a solid absorbent impregnated with a volatile base reactant reactive with said acid reactant to form a smoke, a second flexible perforated envelope enclosing said second ampoule and adapted to contain said second reagent when the ampoule is broken, said envelopes being contained and spaced lengthwise within a pliable conduit, whereby the ampoules can be broken by squeezing the conduit.

2. A device according to claim **1** in which the said envelopes are situated between porous plugs within said conduit.

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