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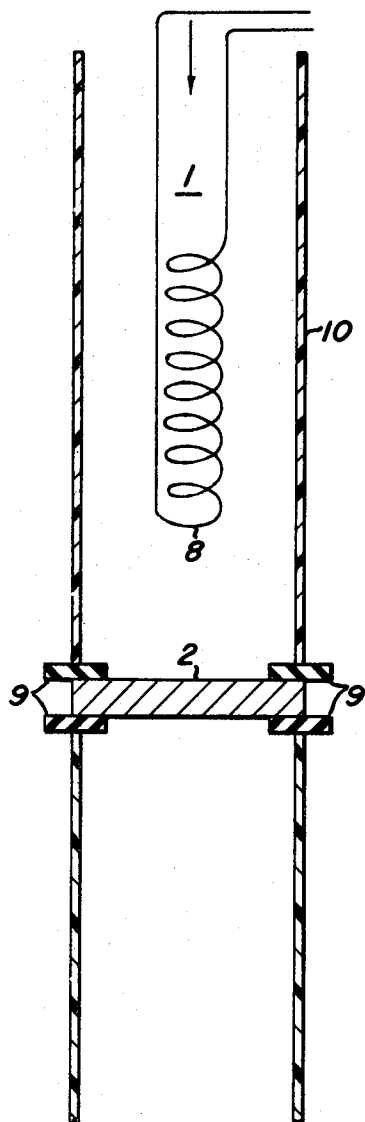
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HEATED CHEMICAL CONVERSION FILTER ASSEMBLY FOR AEROSOL ANALYSIS

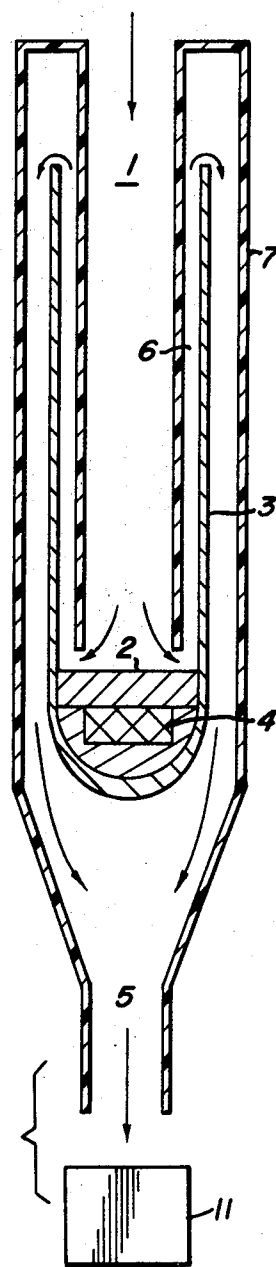
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Fig. 1



PRIOR ART

Fig. 2



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HEATED CHEMICAL CONVERSION FILTER ASSEMBLY FOR AEROSOL ANALYSIS

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2 Claims

ABSTRACT OF THE DISCLOSURE

Improved heater means-prefilter assembly and method for utilization in nerve gas detection devices, whereby air containing aerosol is sampled, the air sample is passed over a prefilter element to wet the prefilter element surfaces with aerosol, and the surface of the prefilter element is heated by an isolated heater means from the nonactive side to convert the aerosol particles on the prefilter active surface to vapor analog to pass to a vapor detecting means.

My invention relates to an improved nerve gas detection device wherein a heater means is arranged to provide for positive detection of a nerve gas.

Nerve gas devices must respond to chemical agents, which are normally vapors as well as those which have very low vapor pressures. Such nonvolatile agents normally are dispersed as aerosols having particle sizes generally lying between 1 and 50 microns. Detectors presently in use will not respond chemically to toxic agents normally encountered as an aerosol, and such detectors have included in them a chemical conversion prefilter which is designed to convert aerosol droplets drawn into the prefilter to the normal gaseous agent, or vapor analog, that is readily detected. The conversion reaction of aerosol to vapor analog will proceed well only above or near room temperature. Therefore, in cold weather operation, the aerosol laden air must be heated in order to assure conversion to the vapor analog of the aerosol droplets stopped by the filter. The need for a heating system brings about the problem for requiring much power to operate the detector; the room temperature power requirement is at least doubled under arctic conditions. In addition, an appreciable pressure drop across the prefilter in prior art devices created a pumping resistance, and a crack in the prefilter, a common occurrence due to the fragility of the item, prevented aerosol detection inasmuch as the air stream took the path of least resistance through the crack. In view of these problems, the prior art detectors required large area filters to reduce the pressure drop, critical gasketing, and a device which was difficult to service. Initial attempts in the prior art devices to solve the above problems sought merely to incorporate a heater in advance, or at the inlet side, of the prefilter. However, this arrangement proved unsatisfactory due to the conductive losses to the surrounding supports which were equal in power dissipation to the useful heating of the air stream. This was due, of course, to the fact that air-to-solid heat transfer is much less efficient than solid-to-solid heat transfer, especially at low air flow rates. The prior art device required heating the entire air stream in order to heat the aerosol droplets contained in it, and was wasteful of power. Conductive losses, although minimized, were as significant as the convective heating required.

It is a specific object of my invention to provide a nerve gas detector prefilter assembly which provides positive detection at all temperatures at significant power saving.

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It is a further object of my invention to provide a detector which does not require large area filters, does not require gasketing, eliminates pressure drop across the prefilter, is easily serviced, and heats substantially only the prefilter and thus the aerosol impacted thereon and not the whole air stream.

Other objects of my invention will be obvious or will appear from the disclosure hereinafter set forth.

According to my invention, air laden with aerosol particles enters at 1 in FIG. 2. The air stream impinges upon conversion prefilter 2 in FIG. 2 with a velocity determined by the geometry and flow rate of the assembly and system. The prefilter 2 is heated by a heating element 4 in contact with the inactive surface of the prefilter which brings about efficient heating due to direct conduction by means of solid-to-solid contact. The heater 4 is mounted in a thermally insulating tube 3 which is readily removable for replacement and cleaning of the prefilter, and the heater element is isolated from the air stream by insulation means; tube 3 serving as a baffle means to assist in the elimination of pressure drop across prefilter 2. The prefilter geometry is designed for a given aerosol particle size based on flow rates anticipated to be encountered. Particle sizes of aerosol larger than the design diameter will impinge on the prefilter, wet the surface, be chemically reacted to form vapor, and pass upward through the annulus 6 in FIG. 2. Thus, the droplets wetting the prefilter surface are heated to prefilter temperature, the aerosol is thus converted to vapor analog, and the air stream continues onward without carrying away valuable power in the form of heat. This, of course, is due to the prefilter alone being heated and not the air stream due to the insulation means. The detection system of my invention operates with a high degree of efficiency because only through conversion to a vapor can the toxic agent be carried upward through the annulus and on to detection by the air stream. The only cooling effect, power waste, other than the small conductive loss to tube 3 in FIG. 2, is that due to the passage of low velocity air over the filter surface which is small due to the inefficiency of the gas-to-solid type of transfer. Illustrative of the power savings for arctic conditions; the prior art devices would require 5 to 8 watts to preheat the system properly, whereas my invention only requires 1 watt under the same conditions.

FIG. 1 is a cross sectional view of the prior art detector.

FIG. 2 is a cross sectional view of my improved detector. I will now describe the figures in detail:

FIG. 1 shows a housing 10 containing a prefilter element 2, gasket 9, and heater means 8. As can be seen, the air stream is heated and not merely the prefilter element 2. Any crack in the prefilter allows the airstream and aerosol to pass straight through.

FIG. 2 shows a detector housing 7 enclosing prefilter element 2 having an active surface to chemically convert aerosol particles to vapor analog and a non-active surface, heater element 4, and support element 3. Heater element 4 is mounted to contact the non-active side of prefilter element 2 and the prefilter-heater elements are mounted on support 3. An annulus space 6 is provided as a result of the configuration of support 3 and housing 7, and permits the passage of air laden with vapor analog to exhaust to space 5 for transmission to the detection element 11.

It is obvious that other modifications may be made, and I desire that my invention be limited only by the scope of the appended claims.

I claim:

1. A gas detection device for detecting the presence of toxic gases in an air stream containing aerosol particles

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including an open housing wherein the improvement in combination therewith comprises a chemically active conversion element to convert the aerosol particles to a vapor analog within said open housing, said element having a chemically active surface and a chemically inactive surface opposite to the active surface; a heater means contacting the chemically inactive surface of said element, said heater means being in a chamber means and isolated from the air stream by insulation means; insulation means contacting each end of the conversion element to form a chamber to isolate the heater means from the air stream; a baffle means in juxtaposition to the insulation means whereby a pressure level is sustained across the chemically active conversion element; and a conduit means to transport the vapor analog to a detection means.

2. A method of detecting gases comprising the steps of providing a means to sample air containing aerosol particles from an air stream, isolating a heater means for a conversion element from the air stream to provide insulation means, passing the sample of air over a chemically active surface of the conversion element, wetting the conversion element chemically active surface with the aerosol particles within the air sample, heating the chemically active surface of the conversion element from

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a chemically non-active side of the conversion element to convert the aerosol particles on the chemically active surface of the conversion element to a vapor analog, converting the aerosol particles by chemical reaction on the chemically active surface of the conversion element to the vapor analog, sustaining a pressure level across the chemically active surface of the conversion element through restricting flow of the air stream by a baffle means, passing the air stream containing the vapor analog to a gas detecting means, and detecting the gas.

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