Oct. 17, 1972 G. A. BRENNAN 3,698,871

AIR POLLUTION DETECTORS

Filed April 16, 1970

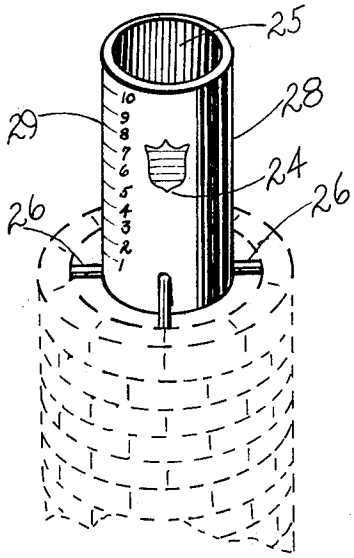


FIG. 2.

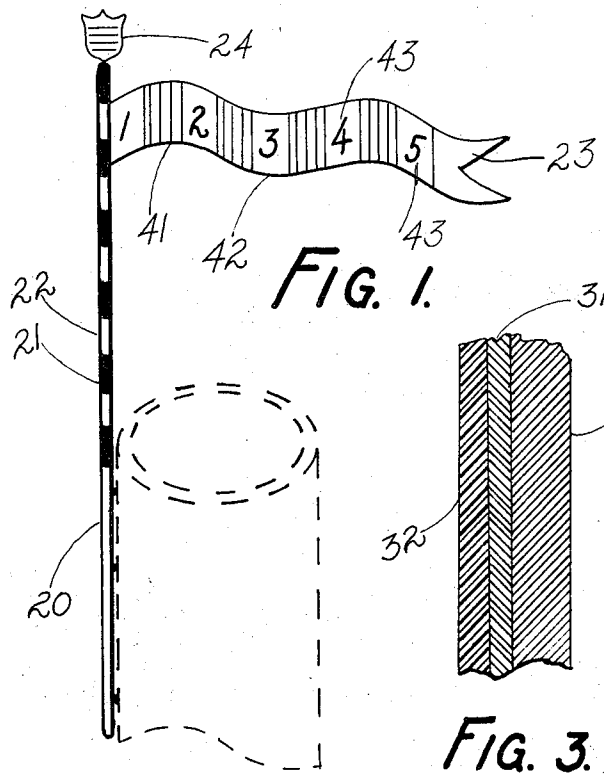


FIG. 1.

FIG. 3.

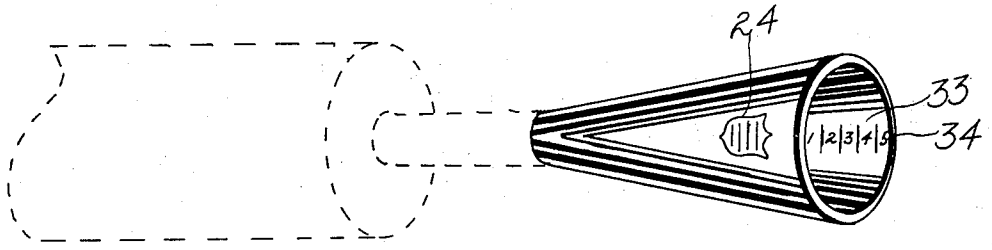


FIG. 4.

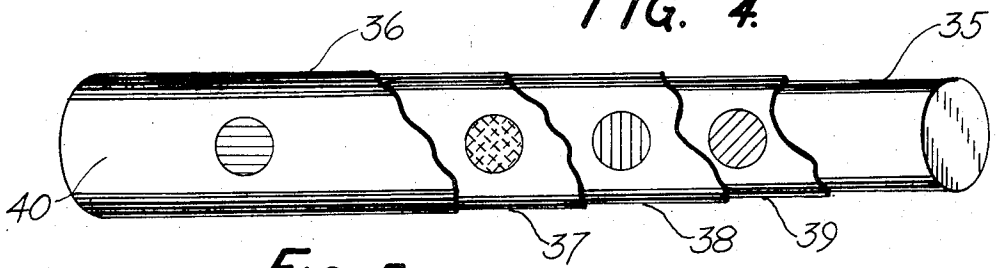


FIG. 5.

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AIR POLLUTION DETECTORS

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ABSTRACT OF THE DISCLOSURE

An easily seen, standardized surface, such as that of a mast, mounted in the effluent discharging from a potential source of air pollution, such as a chimney, to provide a visible surface on which can be accumulated an informative record of the condition of the effluent, since the device was installed.

STATE OF THE ART

A major problem in the enforcement of air pollution control ordinance is that sources of potential pollution may operate at infrequent intervals, or pollute only intermittently, or only at night. Where the pollutant is in the form of gases or vapors which are invisible, the problem becomes even more difficult.

Making door to door inspections of potential sources of pollution has been the most effective solution. This may require a large policing force, and can be a costly procedure.

OBJECTS OF THE INVENTION

It is an object of this invention to provide a simple, inexpensive, visual recording device, which can be installed in the effluent of established exhaust outlets, to record the presence of both particulate and certain gaseous air pollutants, by either an accumulation on, or eroding of the surface of the indicator.

It is an object of this invention to make a general inspection of air pollution recording devices possible from a low flying aircraft, or a surface vehicle.

It is a further object of this invention to provide a means of identifying certain gaseous pollutants at their source.

Other features and objects of the invention will be more fully understood from the following description and the accompanying drawings:

GENERAL DESCRIPTION

FIG. 1 is a perspective view of one embodiment of the invention, showing a mast and pennant and their relationship to the mouth of a vertical flue when installed.

FIG. 2 is a perspective view of another embodiment of the invention, showing the installation of a tubular design, in relationship to a factory chimney.

FIG. 3 is a sectional detail of a two layer reactive coating in one embodiment of the invention.

FIG. 4 is a perspective view of another embodiment of the invention, showing a conical, truncated design, as installed on an automotive exhaust.

FIG. 5 is a perspective view of another form, showing multiple layers of a corrodable coating stepped down and cut away.

THE BASIC PRINCIPLE

Up until now, the blackened mouths of chimneys handling large volumes of heavy smoke have been commonplace. This condition, in itself, is of little or no value in determining the current rate of air pollution. By installing a standardized collector surface periodically, at the mouth of the chimney, however, quite useful information can be obtained, without ever entering the building. All that is needed is to observe the degree of sooting on the collector.

It is also well known that air pollutants deteriorate nearly every type of material to which they are exposed. By surfacing the collector with material having a known pollutant related decay behavior, this deterioration can be a useful gauge of gaseous pollutants present in the effluent.

DETAILED DESCRIPTION

Referring to FIG. 1, a mast **20** is mounted at the mouth of an oil fired household or industrial type furnace flue. By having a similar installation on every chimney, an inspector can fly over an area and visually observe which masts have accumulated excessive quantities of soot or smoke. The markings **21** and **22**, aid in judging the accumulation, by the degree to which they are discolored or obliterated. Particulate matter will normally collect on the mast in a ratio inversely proportional to the distance from the mouth of the flue. Thus, the discoloration will start to be visible at the base of the mast first, where exposure is greatest. In time, the discoloration will become visible higher and higher on the mast. When the soot reaches an opaque state, the markings become totally obscured. By observing the distance from the mouth of the flue, to which the markings are totally obscured, a relatively reliable indication of the volume of particulate to which the mast has been exposed, will result. This may vary from one geographic location to another, due to weather conditions, but, in a given location, a standard can be established, by noting the rate of build-up on a properly operating installation. Looking at a group of these chimney top recording devices, those with an abnormal accumulation will be easily distinguishable.

The streamer **23** serves as a movable collecter surface, which responds to both the flow of the effluent, and also to changes in wind direction. This keeps the streamer downwind of the flue, and in the effluent a high percentage of the time.

If the streamer is made from a fabric, it tends to entrap fine particulate aerosol, which might otherwise fail to collect on the mast. The collection of aerosol can be further enhanced by the use of an oxidation resistant, waterproof oil, such as methyl silicone. This may be applied selectively, as through a stencil, so that a pattern of aerosol will gradually darken a part of the collector surface. The stencil technique also makes the unauthorized cleaning of the collector surface readily detectable. Greases may be used in place of oils for the collection of aerosols.

The streamer **23** also serves as a means of estimating the age of the installation, due to the gradual deterioration of the fabric from atmospheric conditions. In a given area, all comparable installations should fray, fade, and discolor at approximately the same rate. Rapid deterioration of the fabric would indicate the presence of a destructive chemical in the effluent, or, might indicate that the streamer had not been replaced at the required time.

In any case, an installation which does not match the others in the area, would be conspicuous, and would warrant investigation.

The streamers can be made of various materials, including natural and synthetic fabrics, ranging from linen and cotton, to fiber glass and acrylic resin. It may also be made of non-woven webbing, or from solid, flexible sheetings, such as foils or sheet plastics, or any combination of these.

The streamers also aid in locating installations which might otherwise be overlooked on inspection tours.

On all installations, it is desirable to have an official data and authentication area. This may be in the form of the seal and data blank **24**, where information pertinent to the installation can be recorded, and the authenticity of the installation can be established.

The design depicted in FIG. 2 is tubular, with a central passage **25**. The unit is intended to be mounted directly over the mouth of a chimney, by brackets **26**, so that the effluent passes largely through the interior **25**, but at least some of the effluent passes over the outer surface **28**. This is assured if the outside diameter of the collector is less than the inside diameter of the flue on which it is installed. While the unit may be installed partially in the mouth of the flue without seriously obstructing it, it is intended that a substantial portion of the unit project above the normal mouth of the flue so that the graduations **29** will be visible from a ground position. Other types of markings are, of course, optional.

On industrial installations, or wherever noxious gases may be present in the effluent, it is desirable to have the surface of the collector coated with a chemical which will undergo a visible change in the presence of the gas or gases concerned.

Lead carbonate is one such chemical which will turn from white to a dark grey or black in the presence of hydrogen sulphide. The chemical may be in the form of a pigment, in a paint or lacquer vehicle.

To reduce the sensitivity of the chemical to a gas, one or more coats of a protective, transparent coating may be applied over the chemical surface. This should have a limited porosity to the gas, so that the underlying chemical will react, but more slowly than in the unprotected state. FIG. 3 shows a substrate **30**, bearing a chemically reactive coating **31**, and a protective overlay of a porous resin **32**. The resin may be one of the many used in general paint technology, such as acrylic resin, alkyd resins, urethane, vinyl or other natural or synthetic vehicles or varnishes, including linseed oil and tung oil.

Among other useful indicators of various noxious gases, are the metallic pigments, especially those of copper and its alloys. Copper, brass, bronze, silver, magnesium, aluminum, zinc and other metals may also be useful in foil or ribbon, as well as sheet form. Copper reacts with many gases, such as those of ammonia, sulphur dioxide, nitrous oxide, and other corrosive fumes. By placing a coating of a porous resin over a polished sheet of brass, extensive exposure to any of a number of common air pollutant gases will discolor the metallic surface. Some of the discolorations are typical, and indicative of the chemical present.

FIG. 4 illustrates a conical design which is well suited to horizontal exhaust systems, such as those most used for automotive internal combustion engines. As the inner surface **33** is visible on installations of this type, the markings **34** are useful in this location. The recessed collector surface **33** is largely protected from the weather conditions, as well as other physical contacts which might disturb the accumulated particulate. The flaring design also reduces the velocity of the effluent, and lowers the surface temperature of the device.

FIG. 5 illustrates another form of indicator. This is composed of variously colored coats of paint or enamel on a base **35**. It is well established that air pollutants have deleterious effects on painted surfaces. By exposing a series of coats of paint or enamel **36**, **37**, **38**, **39** to concentrated fumes or vapors, any accelerated deterioration of the surface **40** can be attributed to the pollutants present. This deterioration of painted surfaces, is among the most versatile of all pollutant indicators, although the causative may not be clearly indicated. It can be used to detect a wide range of organic fumes, olefins, unsaturates, hydrocarbons and other solvents, as well as acid fumes.

PREFERRED FORM

A preferred form of the invention consists of an aluminum tubular mast about 1½" in diameter, and approximately six feet long. This is painted with a white lead carbonate pigmented linseed oil based paint. When dry,

bands of bright metallic brass pigment in a clear acrylic resin lacquer are applied to give alternate bands of white and gilt. A clear acrylic lacquer is applied over the pigments to make them generally resistant to prevailing levels of general air pollution for a period of approximately one year.

At the top of the mast is a small metal escutcheon bearing an official seal of the control authority, with space on the reverse side for the date of the installation and the installer's name. Just below the top, is secured a Dacron polyester fabric streamer approximately 4 feet long by about 6 inches in width. This bears alternating red and white areas **41** and **42**. The white areas bear numerals **43**, printed in tinted methyl silicone oil.

The mast and streamer are mounted to the top of a residential house chimney, which serves as a flue for an oil fired hot water furnace. About 5 feet of the mast projects about the mouth of the flue. It is also desirable to have a separate or combined license number, which can be easily identified with the installation and read by patrolling inspectors.

The installation will effectively monitor the operation of the furnace on a twenty-four a day basis, for a period of a year or more. A significant emission of smoke or soot will collect on both the streamer and the mast, until the markings are finally obliterated completely. If the fuel was not refined to remove sulphur, this will cause the gilded areas of the mast to darken. If the gaseous effluent contain hydrogen sulphide it will also blacken the lead carbonate pigment. If other corrosive gases are present, they will probably attack the brass pigment, and rapidly deteriorate both the fabric of the streamer and the surface of the paints. Unburned fractions of the fuel oil may be expected to attack the paint vehicles, especially the linseed oil.

A patrolling enforcement officer, upon seeing any of these or other signs of illegal operation, would take note of the license number and list it for an on site inspection.

Various other embodiments of this invention are possible without departing from the spirit of the invention. This is especially true in the use of other chemicals and materials as surface indicators.

I claim as my invention:

1. A device for monitoring and policing air pollution at its source, on a cumulative long term basis, which consists essentially of a unit suited to be mounted at the point of discharge to the atmosphere of a potential air pollution source, in a position visible to vehicular inspection, said unit bearing a data recording surface, an indicator surface capable of being visible altered by any of a plurality of pollution causing substances to which it may be adapted and is exposed, and a series of graduated markings on said indicator surface, said markings running essentially in the direction of flow of the effluent, and serving to measure the progressive deterioration of the pristine condition of the said indicator surface material, the said apparatus simultaneously recording the sum of the air pollutants to which it is adapted and exposed, the degree and type of visible change in the appearances of the said indicator surface being typical, and in relationship to the degree and types of pollutants to which it is exposed, and being suited to interpretation by a visual comparison with controlled units, similarly installed on comparable installations for the same time period and in the same geographic locality.

2. The device of claim **1**, in which the said surface bears a substance capable of visible change in the presence of a particular air pollutant gas.

3. The device of claim **1**, in which the said indicator surface is a material capable of corroding at an accelerated rate, in the presence of a concentrated effluent containing a vaporous corrosive chemical to which the said indicator surface material will visibly react.

4. The device of claim **1**, in which the said indicator surface is oily.

5. The device of claim 1, in which the said indicator is a movable webbing, capable of orienting itself to prevailing air currents.

6. The device of claim 3, in which the said indicator surface material contains a metal taken from the group consisting of copper, brass, bronze, silver, aluminum, magnesium, lead, and zinc.

7. The device of claim 6, in which the said surface is protected by a gas permeable layer of a transparent coating material.

8. The device of claim 1, in which the shape is tubular, and suited to be mounted in the mouth of a flue, with a substantial portion extending outside the said flue and providing an open passage through the interior of said device for a portion of the effluent, but with the external diameter of the said device being less than the inside diameter of the mouth of the said flue, so that at least a portion of the said effluent passes over the exterior surface of the said device after escaping from the said mouth of the said flue.

9. The device of claim 1, in which the said indicator surface material and the said graduated markings are on the internal surface of a conical nozzle-like unit, suited to be mounted at the discharge end of an effluent duct, in an essentially horizontal position, with the flaring end of the said conical unit in a terminal position, and suited to the visual inspection of the said internal surface.

10. The device of claim 1, in which the said indicator surface material is composed of multiple coats of variously colored paint having a pollutant related decay behavior.

11. The device of claim 1, for monitoring relative amounts of pollutants contained in the effluent from a flue stack comprising a mast and flag extending vertically from the top of said flue stack, said mast bearing reactive material capable of giving a visual indication by reacting with pollutants in said effluent, and said flag being constructed from a fabric-like material capable of orienting itself to prevailing wind currents, and having a known pollutant related decay behavior.

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23—232 R; 73—28; 116—114 R, 114 AM