MERCURY AIR SAMPLER FOR GEOLOGICAL STUDIES

BACKGROUND OF THE INVENTION

Instrumentation for quantitating the amount of mercury found in the air particularly useful in conducting geological explorations and studies having high sensitivity or the ability to measure very small mass concentrations in the order of for example 1.0 nanogram per cubic meter of air, the approximate background level, have been devised. Measurement of mercury in the air and soil as an indicator during exploration for many base, and precious, metal ore deposits has been an accepted technique for a considerable period. In general, all gas-measuring instruments heretofore known have utilized procedures including: absorption of the mercury from the air sampled onto the surface of a noble metal wettable by mercury; desorption as vapor by heating the collected mercury; and estimation of the mercury vapor by measurement of its optical absorption at the wavelength of a mercury resonance line (253.7 nm., usually) in an ultraviolet photometer.

Known devices have been difficulty portable. Normally they required that samples of mercury collected from the air, the soil or soil-air be transported to a central analytical station for determination of the indicator vapor. Such procedure is time consuming and inefficient with respect to conducting geological surveys. Additionally, in order to utilize a random of the absorbent material, usually gold or silver foil or wool, desorption was carried out with the assistance of an induction furnace which is expensive, bulky, heavy and requiring relatively high power inputs.

A wholly satisfactory solution for geological applications resolving problems associated with mercury vapor measuring have not been available.

SUMMARY OF THE INVENTION

The present invention is directed to apparatus and system for mercury air sampling and measurement especially adapted for geological surveying, studies and the like realizing an easily portable system which can operate from storage batteries such as automobile or truck types or alternator power readily available and transportable to areas where testing is to be conducted. One useful embodiment of such a mercury sampling device consists of two grids of silver wire mounted at opposite ends of a rotor adapted for revolving at high speeds, such as for example 1,500 r.p.m. The silver wire of the grids is supported on an insulated frame so that the wire and frame conjointly can be easily removed from the rotor, transferred to a sealable airtight compartment and heated by direct passage of electrical power through the grid to desorb the amalgamated mercury. The mercury vapor resulting, as released from the surface of the silver wire upon heating, is carried by an airstream into a cell for determination of mercury content by means of a photometer operating for example at a wavelength of 253.7 nm. Photometers specially designed for given airflow rates and geometry of sampler grids and related heating requirements are known in the art.

A number of collector grid configurations may be utilized including U-shaped bars, split circles, or supported foil vanes. These collection surfaces may be mounted on the extremities of a rotor or with on-axis geometry.

The present invention utilizes a new technique including a consecutive heating method wherein two grids in the sampler are heated consecutively rather than simultaneously, as in the prior art, to obviate ejecting into the photometer all mercury vapor together with possible interferences such as might be obtained from absorbed hydrocarbons. The consecutive heating of the grids results in obtaining a first measure of signals caused by materials other than mercury while simultaneously concentrating the mercury from the first grid on the second grid. Subsequently, when the second grid is heated, the photometer signal which results is electronically decreased by the signal from the first grid. This procedure corrects the signal caused by mercury vapor for whatever interferences may be absorbed on the sampler. The resultant light absorption as measured by the photometer is, after appropriate calibration, directly related to the absolute amount of mercury vapor in the air and these results can be directly correlated with the geological information sought.

Additional objects and advantages of the present invention will be more readily apparent from the following detailed description of a preferred embodiment of apparatus for practicing the invention when taken together with the accompanying drawings in which:

FIG. 1 is a schematic elevational view, partly in section, of a sample collector and drive unit;

FIG. 2 is a plan view taken substantially on the line 2–2 of FIG. 1;

FIG. 3 is a sectional view through a vaporizing chamber, with a sampling grid inserted therein, for vaporizing mercury collected during a sampling step;

FIG. 4 is a sectional view taken on line 4–4 of FIG. 3;

FIG. 5 is a schematic of the electrical/electronics circuitry; and

FIG. 6 is a graph depicting photometer signals plotted against mercury vapor concentrations for obtained test data.

Referring to the drawings in detail there is shown a preferred design for practicing the invention utilizing the inventive concepts as indicated above. It is to be understood that the depicted apparatus is illustrative of a single preferred design and that other apparatus specifics can be utilized in practicing the concepts of the invention.

In the form of the invention shown the entire device is of a nature and size adapted for ready portability to a test area and there operable for conducting the complete sampling and testing procedures required for geological surveying and the like. As designed, the apparatus requires only a 12-volt source of power for operation. Desired readout instrumentation, not specifically shown, can consist of information converters and printers and which can be at convenient on- or offsite locations.

The shown apparatus includes, generally designated, a sample collector unit **10** rotatably mounted by and on a motor housing and mounting structure **12** through a driven shaft **14** and bearing **16** in bearing housing **18**, washer or collar **20** and securing nut **22**. A two-arm rotor blade **24** is secured on the shaft for rotation by a drive motor operable by for example a 12-volt power supply such as a vehicle battery. On each rotor blade **24***a*, **24***b*, preferably aluminum, there is detachably mounted a collector grid assembly **26**. The collector grid assembly includes, as a grid-mounting frame, a lower bar **28** and an upper bar **30** preferably of hard anodized aluminum which interconnect and are mounted on posts **32**, preferably also of hard anodized aluminum for insulation and secured by any appropriate means. The posts **32** are threaded as at **34** with an appropriate pitch and around which is wound silver wire of for example 0.020 diameter size with the wire wound around every thread pitch and having the ends secured as at **36** by any appropriate means. The silver wire as mounted constitutes a collection grid for mercury in air being tested during the air-sampling operation and with the rotor operating.

Any desired mounting means for the collector grid assemblies can be used but as contemplated and shown the mounting means generally designated **38** are of a nature such that the collector grid assemblies can be easily and quickly mounted on or removed from the rotor. Such means can include for example studs **40** slidably mounted in slots **42** with the studs being adapted for supporting engagement with supporting surfaces and areas including openings **44**, which can be slots if desired for easy assembly and lips **46** engageable on the studs or posts **40** as shown in FIG. **1**. Fastening members **38** are slidably mounted in slots **50** in the rotor blades and are provided with lips or projections **52** in the nature of extending noses for coacting securement engagement with the lip portions **46** of lower bar **28**. Securing movement of fastening members **38** is indicated in FIG. **2** by arrow **54**.