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GAS DETECTING APPARATUS

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Fig. 1.

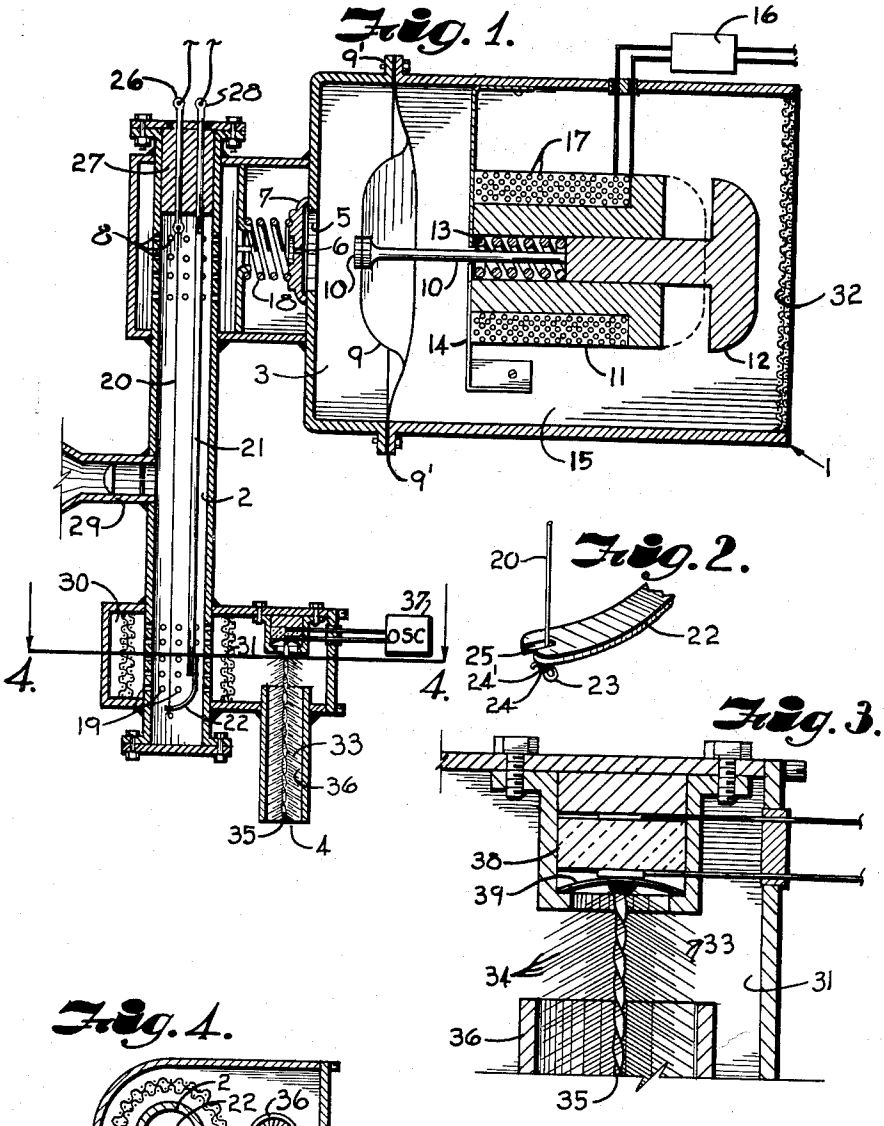
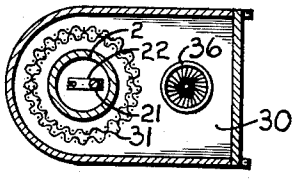


Fig. 2.

Fig. 3.

Fig. 4.



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GAS DETECTING APPARATUS

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This invention relates to gas detecting devices and more particularly to an improved apparatus for drawing gas samples for analysis.

The principal objects of the present invention are: to provide a gas sampling apparatus which is self-cleaning so as to furnish substantially particle-free samples for analysis without the necessity of frequent filter changes; to provide such a device adapted for safe use in an explosive atmosphere; to provide such an apparatus which is entirely automatic in its operation and requires little maintenance; to provide an improved gas detecting apparatus which "breathes" so as to produce a rapid gas sample exhaust cycle which dislodges particles from the filter and a slow intake cycle to facilitate analysis without excessively cooling the hot filament required for the analysis; to provide such a device in which the filter is composed of a plurality of fine wires having free ends pointing roughly opposite to the direction of inward gas flow; to provide a filter having a plurality of fine wires which vibrate at ultrasonic frequency during the exhaust cycle in order to aid in dislodging particles captured thereon during the intake cycle and to provide such a device which is inexpensive to build and reliable in use.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein are set forth by way of illustration and example certain embodiments of this invention.

FIG. 1 is a sectional view in side elevation of a gas detecting apparatus embodying the breathing and filtering features of this invention.

FIG. 2 is a detail perspective view of the filament and filament retaining spring of the apparatus.

FIG. 3 is a detail sectional view of the filter and vibrator.

FIG. 4 is a sectional view taken on the lines 4—4, FIG. 1, showing the relationship of the fire screen and throat of the gas detecting apparatus.

Referring more in detail to the drawings:

The numeral 1 designates generally the housing of an apparatus for detecting certain fractions or traces of gases in the atmosphere or in other gaseous mixtures. The apparatus is generally comprised of an analysis chamber 2, a storage chamber 3 and an entrance portion or throat 4 each formed by the interconnected walls of the housing 1. The storage chamber 3 is closed except for an opening 5 through which the chamber 3 communicates with the analysis chamber 2 via a passageway 6 contained in a poppet valve 7 (described hereinafter) and a plurality of small openings 8 in the upper portion of the analysis chamber 2. The storage chamber 3 has one wall thereof formed by a flexible bellows 9 which is maintained in position by flanges 9' on the housing 1. The central portion of the bellows 9 is fixed to a rod 10 which extends into a reciprocable motive device, in the illustrated example on solenoid 11 where it connects with a solenoid armature 12 slidable with respect to the solenoid. A spring 13 urges the armature 12 in a direction away from the storage chamber 3 causing the flexible bellows 9 to move in the same direction, increasing the volume of the storage chamber 3. The solenoid 11 is rigidly supported by means of a bracket 14 in an outer chamber 15 formed by the walls of the housing 1 and the bellows 9. An automatic timer 16, the purpose of which is described more fully hereinafter, periodically activates to

energize the coil 17 of the solenoid 11 which produces a magnetic field causing the solenoid armature 12 to rapidly translate toward the solenoid 11 as indicated by the broken lines in FIG. 1. This translation compresses the spring 13 and also moves the flexible bellows 9 toward the opening 5 forcing gas contained in the storage chamber 3 against the poppet valve 7. The poppet valve 7 is retained in position by means of a compression spring 18 which yields under the force of the outgoing gas to permit said gas to rush outwardly at a high rate from the storage chamber 3 and through the small openings 8 into the analysis chamber 2.

The gas passing through the small openings 8 during the exhaust cycle is guided downwardly through the analysis chamber 2, through the small openings 19 in the lower portion of the analysis chamber 2 and out of the apparatus by way of the throat 4 in a manner that will be more fully explained hereinafter. When the timer 16 no longer applies the current to the coil 17, the spring 13 urges the bellows 9 away from the opening 5 causing a partial vacuum in the storage chamber 3 which induces gas to enter the chamber 3 at a slow rate through the passageway 6, which is small in cross sectional area compared to the opening 5. Thus on the intake cycle of the apparatus, the gas travels at a slow, steady rate into the throat 4, upwardly through the analysis chamber 2 and into the storage chamber 3.

The walls of the housing 1 forming the analysis chamber 2 are preferably of wrought iron and the chamber 2 contains a suitable heatable filament 20 maintained in a taut condition by means of a supporting rod 21 and a leaf spring 22. The filament 20 is looped at the lower end 23 thereof and maintained in this condition by a small measure of silver solder or the like 24 forming an enlarged anchoring portion 24' which rests against a slot 25 in the spring 22 as shown in FIG. 2. The upper end of the filament 20 is anchored to an electric wire terminal 26 supported in a ceramic insulator 27. The upper end of the supporting rod 21 is also supported in the ceramic insulator and is spaced from the terminal 26. The rod 21 terminates at the upper end thereof in an electric wire terminal 28. Current applied through the terminals 26 and 28 heats the filament 20 which then becomes useful, through known means, for analyzing certain gas fractions or traces entering with the sample gas. For example, the thermal conductivity of carbon dioxide differs from that of air by approximately forty percent and a measure of carbon dioxide in air will change the heat transmission to the walls of the analysis chamber 2, varying the temperature of the filament 20 and thus changing its resistance. By monitoring the resistance of the filament 20 the percentage of carbon dioxide in the air sample can thus be deduced. As another example, carbon monoxide can be detected by using platinum for the filament 20 which then acts as a catalyst and produces combustion of the carbon monoxide with the oxygen in the air sample. The carbon monoxide will burn along the surface of the filament 20 thereby raising its temperature and increasing its resistance which becomes a measure of the percentage of carbon monoxide in the sample. A further example is to provide a spectroscope 29 which uses the light generated by the filament 20 in a well known manner to produce an analysis of the gases contained in the chamber 2.

A lower chamber 30 is formed by walls of the housing 1 surrounding the lower portion of the analysis chamber 2 and contains a fire screen 31 fronting the openings 19 which is necessary in case the apparatus is used in an atmosphere which may include explosive components. The fire screen 31 is a fine mesh screen, usually of copper, which prevents an ignition or burning of any gas

mixture from passing therethrough. Another fire screen 32 may be provided between the outer atmosphere and the outer chamber 14 to prevent an explosion in case leakage through or around the bellows 9 permits a flame to enter into the outer chamber 14.

It is highly desirable that contaminating particles such as dust and grease be omitted from the analysis chamber 2, for such contaminants may produce a serious error in gas detection or analysis. To prevent such solid or semi-solid particles from entering the apparatus, the throat 4 is provided with a plurality of fine wires 33 having unsupported ends 34 terminating in various positions within the passageway created by the throat 4 and pointing roughly against the direction of intake gas flow. The wires 33 are .5 to 3 mm. in length and a thickness corresponding approximately to No. 30 American wire gauge and may be of various cross sectional shapes. The wires 33 are supported by means of a central spiral rod or member 35 in the same manner that brush bristles are often held. If desired, the anchored ends of the wires 33 may be secured to the inside surface 36 of the walls of the throat 4 and the unsupported ends 34 would then face inwardly of the throat 4. It is important that the unsupported ends 34 are spaced throughout the cross sectional area of the throat.

The unsupported ends 34 of the wires 33 and the bodies of the wires 33 will provide obstructions to trap incoming dust particles and the like, but permit the gas to pass through the throat 4. The size of the particles trapped will depend upon the wire thickness and density of distribution thereof. As noted above the exhaust cycle causes a high velocity rush of gas downwardly through the throat 4.

This outward gas flow is in a direction which tends to dislodge the particles trapped on the slow intake cycle, thus providing a self-cleaning filter action.

An oscillator 37 may be provided to impress an alternating current of ultrasonic frequency on a transducer or magnetoconstrictor or the like 38 which is held in contact with the supporting rod 35 to induce vibrations in the fine wires 33 during the exhaust cycle to help shake loose the entrapped particles. A conical spring 39 may be provided to maintain the rod 35 in a vibration-receiving position. It is noted that in case the wires 33 are secured to the walls 36 of the throat 4 rather than on a rod 35, the transducer 38 may be adapted to vibrate the entire throat 4.

The timer 16 is caused to cycle at a rate which permits the gas analysis to be completed during the "off" time of the cycle, during which the gas is slowly flowing into the storage chamber 3. Varying the cross sectional size of the passageway 5 will produce the desired rate of upward flow of the gas in the analysis chamber 2 for the particular type of analysis being performed.

It is to be understood that while I have illustrated and described one form of my invention, it is not to be limited

to the specific form or arrangement of parts herein described and shown except insofar as such limitations are included in the claims.

What I claim and desire to secure by Letters Patent is:

1. In a fluid sampling apparatus including a housing having an analysis chamber disposed therein, a throat communicating with said analysis chamber, means associated with said analysis chamber for automatically, alternately inducing a rapid exhaust of fluid therefrom and a slow intake of fluid thereinto, means for directing the fluid flowing into and out of said analysis chamber through said throat, and a filter in said throat, said filter having a plurality of wires with unsupported ends pointed against the direction of fluid flow into said chamber, said unsupported ends being spaced throughout the cross-sectional area of said throat and adapted to trap particles thereon which are suspended in the fluid entering said apparatus during said slow intake, the direction of pointing of said unsupported ends promoting the self-cleaning of said filter during said rapid exhaust.

2. In an apparatus for detecting certain fractions in a gas, a housing having an analysis chamber disposed therein, a throat and a storage chamber each communicating with said analysis chamber, said storage chamber having a wall portion thereof comprised of a flexible bellows, reciprocable motive means operatively connected to said bellows, timing means for periodically actuating said motive means causing said bellows to reciprocate in one direction for inducing a rapid outward flow through said throat, means for biasing said bellows to reciprocate in the opposite direction for inducing an inward flow through said throat, a poppet valve adapted to open to permit said rapid outward flow and close for restricting said inward flow, a passageway permitting gas to bypass said poppet valve at a slow rate for producing a slow speed of inward flow, and a filtering device in said throat for trapping particles suspended in the gas during the inward flow, whereby the particles trapped by said filtering device tend to be dislodged and carried away by said gas during said rapid outward flow.

3. The combination of claim 2 including means for vibrating said filtering device during said rapid outward flow to aid in dislodging the particles.

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