March 26, 1940. W. A. DARRAH 2,194,520

PROCESS AND EQUIPMENT FOR MONITORING FLUIDS

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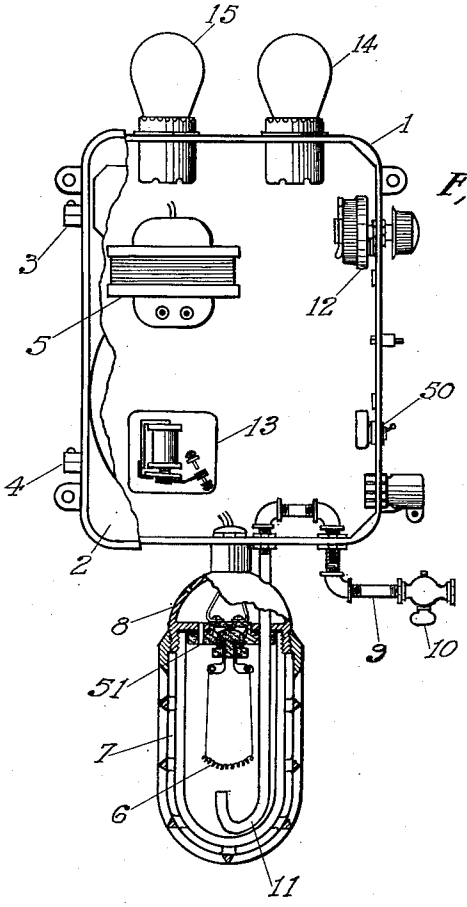


Fig. 1.

Fig. 2.

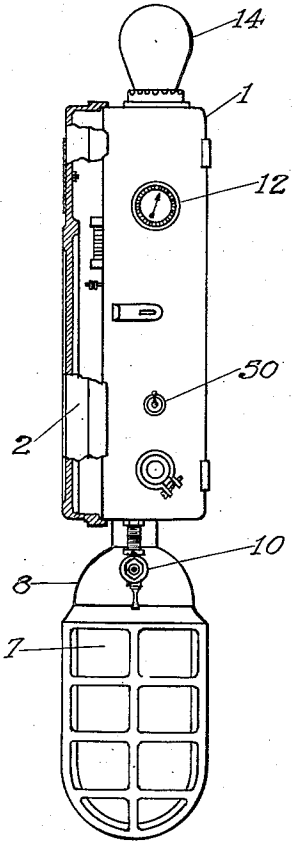
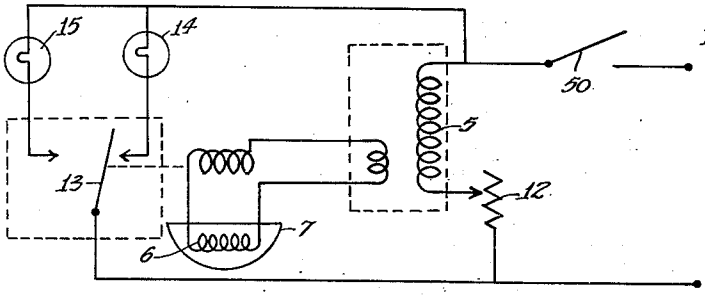


Fig. 3.



Inventor

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PROCESS AND EQUIPMENT FOR MONITORING FLUIDS

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11 Claims. (Cl. 177—311)

This invention relates to processes and devices for monitoring fluids. A specific illustration is the case of a device to continuously sample certain gases and operate an alarm or shunt a valve in case an objectionable gas may be present.

One specific instance is the utilization of this process and equipment as a means of detecting the presence of free oxygen in protective gases. This equipment may be used to detect chlorine, sulphur dioxide, acids and many other materials as will later be set forth in the specifications and claims.

Referring to the drawing:

Figure 1 shows partly broken away a front elevation of one embodiment of my invention, while

Figure 2 shows a side elevation of the same unit.

Figure 3 shows a typical wiring diagram indicating the arrangement of the equipment shown in Figures 1 and 2.

Referring to the drawing 1 indicates a support or housing for the associated apparatus. This housing may well take the form of a box or container provided with a cover 2 which may be opened by means of hinges 3 and 4 for inspection or adjustment.

Supporting frame 1 carries a transformer 5 arranged to supply current to a filament 6 located in a glass globe 7 carried by fitting 8 which in turn is supported by frame 1. A disconnecting switch 50 serves to disconnect the entire circuit from the power line.

A sampling tube 9 provided with control cock 10 delivers a sample of the gases to be monitored through pipe 11 where it is directed on filament 6. Outlet 51 permits the excess gases from around filament 6 to escape into fitting 8 which is not tight and, therefore, into the outside air.

A rheostat 12 is provided to control the flow of current through the 110 volt primary of transformer 5.

The secondary winding of transformer 5 may for convenience be designed to give a voltage of 5 to 10 volts in order to permit convenient diameter and lengths of filaments 6. Obviously the voltages and currents used in this device are merely matters of convenience determined by the size and specific design characteristics. 110 volts can be directly applied to the filament by making it sufficiently long and of small diameter.

The relay 13 is included in the circuit of the filament in such a way that when current is passing through the filament through the relay, lamp 14 will be energized from the 110 volt circuit and lamp 15 will be dark. Obviously if current fails to go through filament 6 and relay 13 the relay will be deenergized and the adjacent lamp 15 which is red, will light and the blue lamp 14 will become dark, thus giving a signal. A typical circuit showing this arrangement of apparatus is illustrated in Figure 3.

Obviously the relay may cause a bell connected in parallel or in series with lamp 15 to ring giving an audible signal in case of failure of current to pass though filament 6.

Filament 6 for many purposes is made from pure copper wire and I have found when using a 10 volt secondary on transformer 5 that a wire having a length of around 25 inches, of the size of #32 or #34 wire gauge, will give satisfactory results. Obviously, I do not wish to be limited to any special diameters or length of wire as special conditions may require a wide variation in these factors.

It is a fact not generally known that copper may be heated to relatively elevated temperatures (1000 to 1500° F.) in the presence of atmospheres containing any amount of water vapor or carbon dioxide and the copper will not be scaled or burned.

On the other hand, a small trace of oxygen or traces of sulphur dioxide, chlorine, etc. will cause a copper wire heated to the temperature range specified to burn through immediately thus interrupting the circuit.

This condition, of course, results from the fact that oxygen and the other gases mentioned will rapidly attack hot copper causing it to scale and under the influence of the continuing current to burn through, thus opening the circuit through relay 13.

It will be evident, therefore, that as long as the sample of gas passing through sampling tube 9 and playing on filament 6 by means of pipe 11 contains no oxygen or corrosive gas, the filament even if strongly heated will remain intact.

Hydrogen, nitrogen, water vapor, carbon dioxide and many other similar materials will have no effect on the copper filament.

It will be evident, therefore, that by the simple expedient of keeping a copper filament heated in the presence of a continuous sample of the gas to be monitored, we have a simple, practical and positive means of obtaining an indication when oxygen or other corrosive gases are present, even in very minute amounts.

This of course forms the basis of a detecting or protective device which forms a part of this invention.

It is evident that the filament must be heated substantially above room temperature in order to obtain the results desired and it is further evident that the preferred results may be obtained when a current is passed through the filament so that the interruption of the current may serve as a means of giving a signal when the objectionable gas is present.

Obviously, my invention is broader than the mere use of a copper filament in a gas which ordinarily does not contain oxygen. For example, if I wish to utilize my detecting device to give an indication in case chlorine gas is present, but do not wish the device to indicate in case oxygen is present, I may use a filament of silver wire.

Nickel chromium wires will be quite resistant in the presence of oxygen, but quite susceptible to slight traces of sulphur compounds.

I consider my invention to include the process and device broadly and reserve the right to modify the nature and dimensions of filaments and all other parts to obtain the desired results with the gases or vapors which it is desired to detect.

One large commercial use of this equipment is in connection with the production of inert gases so called by burning various combustible materials such as fuel gases, oil, etc., creating an atmosphere consisting quite largely of carbon dioxide, nitrogen and water vapor with some percentage of carbon monoxide and hydrogen.

Obviously, many other applications of my device may be made such as monitoring the atmosphere in storage tanks containing combustible or oxidizable gases, liquids or solvents. A typical case is in connection with the storage of paint or varnish, in the oil refineries and in numerous chemical and manufacturing operations where oxygen or other active gases are a hazard.

This device may be caused to serve as a detector for moisture in substantial amounts by using an iron filament in gases which contain no oxygen.

The numerous modifications of the principles here disclosed will be evident.

By using a filament made from carbon similar to a standard incandescent lamp, it is possible to obtain a device which will actuate in the presence of oxygen, carbon dioxide or water vapor and the relative effect of these various gases may be controlled by varying the temperature in which the filament is maintained. It will be apparent, therefore, that this device provides means by which adjusting the temperature of the filament will determine the material to which the filament will respond. This, therefore, gives a means of selecting or controlling the activity of a given filament to various gaseous mixtures.

I wish it to be understood that the operating temperature of the conductor or filament is determined by the nature of the material and its sensitiveness to the gas to be detected. There are numerous commercial materials which can operate successfully at temperatures equal or only slightly above normal room temperatures, for example a ribbon or filament of metallic sodium will readily detect oxygen, water vapor or carbon dioxide at room temperature.

It will therefore be evident that I desire to be unrestricted in the exact temperature used and wish to select a temperature best fitted for the sets of conditions in which my invention will be employed.

It will be evident that while I have specified and described a wire or filament I do not wish to be limited to any special ratio of diameter and length. It will be obvious that the greater the surface in proportion to the volume of the material which forms the sensitive element the more rapidly will the device operate and, therefore, the more sensitive it will be. In all cases maximum sensitivity is not required. Obviously a ribbon, sheet or strip may be used in place of a round wire and in certain cases the cross section of the sensitive element may be very substantial. I have used the term filament as a broad, generic designation to cover the sensitive element used in my invention.

It should be understood that the heating equipment such as the transformer is intended to be connected on a commercial constant voltage circuit which will therefore supply a constant flow of current through the heated wire with any given setting of the rheostat. The rheostat is intended to permit manual adjustment of the current flow through the sensitive wires. The current flow selected will of course remain constant with any given setting of the rheostat due to the fact that the voltage supplied on the supply circuit is constant.

Using the term "gas of the oxidizing group" in the specification and claims, I intend to designate those gases or vapors such as oxygen, sulphur, phosphorous, the halogens, acids, and various combinations of these substances. My intention is to thus classify those gases or vapors which will combine with the filament chemically under operating conditions. I do not wish to be restricted solely to oxygen or to its compounds.

Having now fully described my invention, what I claim as new and wish to secure by Letters Patent in the United States is as follows:

1. A device for monitoring a mixture of gases consisting largely of nitrogen and carbon dioxide, an oxidizable filament insensitive to carbon dioxide or nitrogen, means for maintaining said sensitive filament at optimum temperature and means responsive in case of failure of said filament.

2. In a device for detecting oxygen in a mixture of gases, a housing, a copper filament mounted within said housing, means for introducing a sample of the gas so that it passes over said copper filament and means actuated by a structural change in said filament due to the oxidation of said filament.

3. The means for detecting the presence of a gas of the oxygen group in a gas to be monitored, including a filament exposed thereto and chemically active with respect to said gas of the oxygen group, and means actuated by a structural change in said filament due to the chemical action of the gas of the oxidizing group on the filament.

4. The means for detecting the presence of a gas of the oxidizing group in a gaseous medium to be monitored, including a filament chemically active with respect to said gas of the oxidizing group and exposed to said medium, means for heating said filament to optimum temperature for reacting, and means actuated by a structural change in said filament due to the chemical action of said gas of the oxidizing group.

5. The means for detecting the presence of a gas of the oxidizing group in a gaseous medium to be monitored including a filament exposed to said medium, said filament being chemically active with respect to said gas of the oxidizing group, and means actuated by a structural

change in said filament due to the chemical action of the gas of the oxidizing group.

6. The means for detecting the presence of a halogen in another gaseous medium including a filament exposed thereto and chemically active to said halogen but relatively inert to said other gaseous medium, and means actuated by a structural change in said filament due to the action of said halogen on said filament.

7. The means of detecting the presence of a gas of the oxidizing group in a gaseous medium to be monitored including a filament exposed thereto containing a chromium alloy, means for heating said filament and means actuated by a structural change in said filament due to the chemical action of the gas of the oxidizing group.

8. The means of detecting the presence of a gas of the oxidizing group in another gaseous medium to be monitored including a filament exposed thereto and chemically active to said gas of the oxidizing group, means for heating said filament by an electric current flowing in a circuit containing considerable ballast resistance in addition to said filament, so that the flow of current through said filament is substantially constant in spite of changes of filament resistance.

9. The means of detecting the presence of gas of the oxidizing group in a gaseous medium to be monitored including a filament exposed thereto containing silver, means for heating said filament and means actuated by a structural change in said filament due to the chemical action of the gas of the oxidizing group.

10. The means for detecting the presence of a corrosive gas in a gaseous medium, including a filament selectively sensitive to said corrosive gas and exposed to said medium and means for passing a current through said filament, including a device responsive to current change.

11. The means for detecting the presence of water vapor in a gaseous medium including a filament exposed thereto and selectively sensitive with respect to said water vapor, means for passing a current through said filament including a device responsive to current change.

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