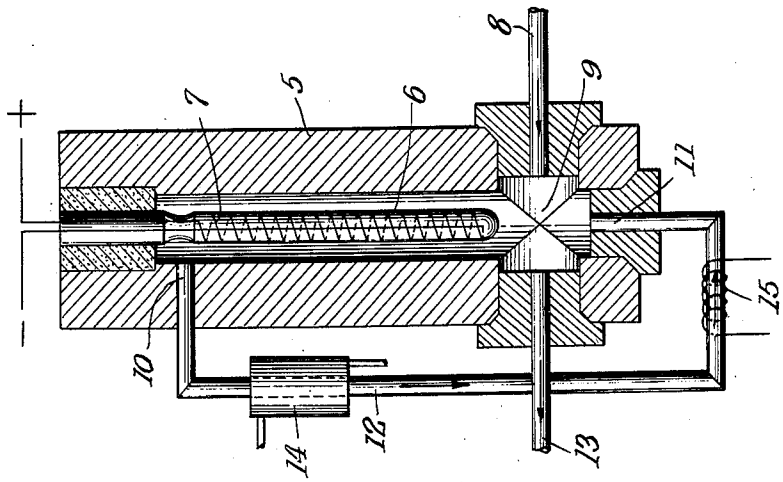
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GAS ANALYSIS APPARATUS

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Fig. 1.



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GAS ANALYSIS APPARATUS

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This invention relates to improvements in apparatus for analyzing gas by the thermal conductivity method.

Electrical gas analysis equipment, based upon the principle of comparing the thermal conductivities of a known gas and an unknown gas and measuring their relative difference has long been known and used. The apparatus consists generally of two or four heating elements placed in opposite arms of a Wheatstone bridge and surrounded by unlike gases.

The temperature difference of the elements depends, by the construction of the device, solely upon the gases surrounding the elements. When the gases surrounding the elements are the same, there is no temperature difference and an indicating or recording instrument connected into the circuit will show a balanced bridge.

However, unless the device is used solely for intermittent measurements, it is necessary to continuously change the composition of the gases surrounding the elements and a difficulty arises due to the fact that a change of the gas stream velocity around the elements will cause a change of temperature of the heating elements. Therefore, the velocity of this stream must be maintained absolutely constant over the several heating elements or the analytical measurements which are desired will be in error due to the difference of temperature arising from gas velocity variations.

Heretofore, two methods for obviating this error have been used. The heating elements may be disposed in chambers so that the atmosphere is in a quiescent state and the change of the atmosphere is accomplished by diffusion. This has the disadvantage of introducing an undesirable time lag in the readings.

The second method is to so arrange the heating elements in chambers so that the atmosphere is changed by convection flow. This flow is, for most purposes, constant enough to give consistent readings and to introduce a far shorter time lag than in the case where diffusion is depended upon for the change of composition. It has however, the disadvantage that when a gas of high density is introduced, the density may be sufficient to almost stop the convection flow and also introduce an excessive time lag.

In apparatus in which the convection method is used, it is found that if light illuminating gas is passed into a typical cell which has air in it, a time lag of between 12 and 15 seconds is all that elapses before a complete reading results. However, when the apparatus is filled with gas and a relatively heavier gas is introduced, such as air, the time required for a complete reading now becomes about five minutes and fifteen seconds.

This undoubtedly, is due to the fact that the heavier gas entering the cell, because of its higher density, almost completely stops the convection flow. It is apparent that a diffusion orifice would considerably cut down the time lag in this case. For changes from air to CO_2, a high time lag also results, whereas, from CO_2 to air, the time lag is considerably shorter because, in this case, the air density works with the convection flow.

It is an object of this invention to obviate errors in gas analysis apparatus by combining the diffusion and convection methods to decrease the time lag of mixing of gases.

A further object is the provision of a gas analysis apparatus having means to produce by diffusion and convection a current of gas, to decrease the time lag.

These and other advantageous objects, which will later appear, are accomplished by the simple and practical construction and arrangement of parts hereinafter described and exhibited in the accompanying drawing, forming part hereof, and in which:

The figure represents a central vertical sectional view of a gas analysis cell embodying one form of the invention.

Referring to the drawing, in the figure a cell block 5 is shown to have a central chamber in which is positioned a quartz envelope 6 having embedded therein a resistance heating element 7. The chamber has an extension 9 which is of equal or larger diameter than the chamber surrounding the quartz envelope 6, in which is introduced by a pipe 8 the gas to be analyzed, the gas leaving by a pipe 13.

Passages 10 and 11, entering respectively the upper and lower ends of the chamber are connected by a pipe 12. In the structure described, a thorough mixing of the gases is obtained by diffusion and convection. The gas is caused to flow by convection through the pipe 12, and also a flow of the gas is caused by diffusion in portion 9 of the chamber.

The mixing of the gases may be further hastened by surrounding the upper portion of pipe 12 with any suitable cooler 14, to cause a cooling of the gases and increase the convection effect. A similar increase in convection is obtained by heating the gases by surrounding the lower portion of the pipe 12 with any suitable means as a heating coil 15. The heater 15 and the cooler 14 may be used separately or jointly, as certain conditions may require.

The accompanying diagram serves to illustrate roughly several possibilities for the construction of the apparatus. The apparatus consists essentially of a combination of conduits, pipes, or openings combining a diffusion orifice with one or more convection orifices in conjunction with the thermal conductivity cell. The convection orifice may be supplemented with flow by convection originating from an outside or external source of temperature difference, such as heating the rising gases, or cooling the falling gases, or both.

The foregoing disclosure is to be regarded as descriptive and illustrative only, and not as restrictive or limitative of the invention, of which obviously an embodiment may be constructed including many modifications without departing from the general scope herein indicated and denoted in the appended claims.

Having thus disclosed our invention, what we claim as new and desire to secure by Letters Patent, is:

1. In a gas analysis apparatus, a cell having a chamber, a resistance heating element positioned in the chamber, said chamber having a lower portion, inlet and outlet conduits through which the gas to be analyzed passes, said conduits communicating with the lower portion, and a pipe communicating with the upper end of the chamber and the lower portion, said pipe entering the lower portion below the conduits.

2. In a gas analysis apparatus, a cell having a chamber, a resistance heating element positioned in the chamber, a conduit through which the gas to be analyzed passes, said chamber having a lower portion in communication with the conduit, a pipe connecting the upper end and the bottom of the chamber, and means for heating the lower portion of the pipe to increase the flow of gas by convection and decrease the time lag.

3. In a gas analysis apparatus, a cell having a chamber, a resistance heating element positioned in the chamber, a conduit through which the gas to be analyzed passes, said chamber having a lower portion in communication with the conduit, a pipe connecting the upper end and the lower portion of the chamber, and means for cooling the upper portion of the pipe to increase the flow of gas by convection and decrease the time lag.

4. In a gas analysis apparatus, a cell having a chamber, a resistance heating element positioned in the chamber, a conduit through which the gas to be analyzed passes, said chamber having a lower portion in communication with the conduit, a pipe connecting the upper end and the lower portion of the chamber, and means for creating a temperature difference between the upper and lower portions of the pipe to increase the flow of gas by convection and decrease the time lag.

5. In a gas analysis apparatus, a cell having a chamber, a resistance heating element positioned in the chamber, an inlet conduit and an outlet conduit communicating with a lower portion of the chamber, and a pipe connecting the upper end and the bottom of the chamber.

This specification signed this 10th day of June, 1931.

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