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R. EISENSCHITZ
GAS ANALYSIS APPARATUS
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Fig. 1.

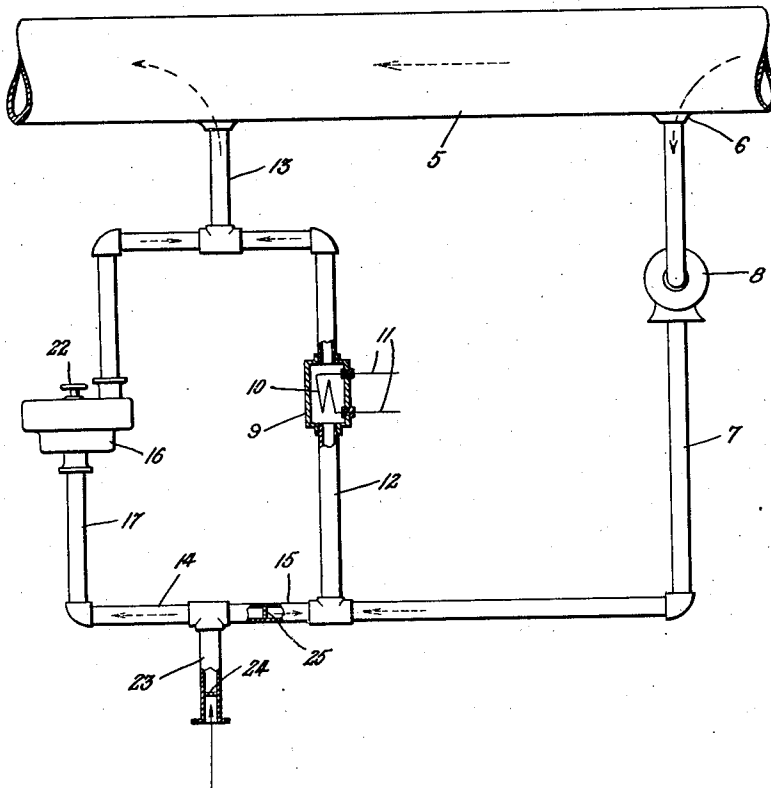
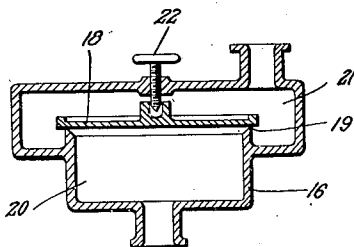


Fig. 2.



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GAS-ANALYSIS APPARATUS.

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The present invention relates to the determination of combustible constituents in flowing gas mixtures, such as flue gases, by means of catalytic combustion of the gas mixture on a metal surface, the heating of the metal body providing the surface, giving a measure of the proportion of combustible constituent. In this process an electrically heated platinum wire is commonly employed to act as a combined catalytic agent and resistance thermometer.

In the application of this process to the analysis of flue gases for example, it frequently happens that the oxygen or combustion supporting medium contained in the latter is insufficient to maintain the catalytic combustion with sufficient speed of reaction. This condition may be remedied by mixing air as the combustion supporting medium with the flue gas to be analyzed and making corresponding corrections in the measurement readings or results obtained. However, in order to obtain reliable measurement results, it is important and necessary to maintain constant the proportion of additional air to the quantity of flue gas conveyed.

If, as is nearly always the case, the suction means used to draw the flue gas sample and the additional air through the measuring apparatus, is subject to variations in suction force or pressure, constant regulation of the quantity of additional air is necessary. With manual control or regulation of the additional air, this necessitates constant operating attention.

The invention, therefore, relates more particularly to an improved apparatus for carrying out the above described catalytic process of gas analysis and has for its object the provision of an improved arrangement and means in such apparatus for automatically maintaining and insuring a constant proportion of mixture between the gas sample and the additional air or combustion supporting medium, whereby manual operation and the necessity for constant attention may be eliminated.

In carrying out my invention, means are provided for supplying a constant current of gas to be analyzed, such as flue gas, to the catalytically operating measuring de-

vice, while the latter is connected with a chamber supplying the fluid combustion supporting medium, such as atmospheric air. A source of suction or region of lower pressure is provided to which the gas sample and said medium flow through the measuring device. The medium in the supply chamber is maintained at a constant pressure with respect to that at the source of suction or region of lower pressure by an automatic regulating device.

For a further consideration of what is believed to be novel and the invention, attention is directed to the accompanying drawing, the description thereof and the appended claims.

In the drawing, Fig. 1 is a diagrammatic arrangement of apparatus for the catalytic measurement or analysis of flue gas and embodying the invention, and Fig. 2 is an enlarged sectional view of a regulating device employed in the arrangement of Fig. 1.

Referring to the drawing, 5 is a gas conductor pipe or furnace flue in which flows a stream of flue gas, as indicated by the dotted straight arrow. A sample of the flue gas is continuously withdrawn from the flue at a suitable point 6, as indicated by the curved arrow, through a sampling conduit 7 in which is located a fan 8 or other suitable means for delivering the sample to a measuring device 9. In the measuring device the proportion of combustible ingredients is determined by catalytically acting combustion about an electrically heated wire 10, the latter being provided with insulated leads 11, which connect with indicating or recording apparatus (not shown) which last do not concern the present invention.

The measuring device is located in a pipe 12 which is connected at its outlet end with a pipe 13 leading into the flue whereby the flue gas sample from the measuring device is continuously returned to the flue from which it is taken, as indicated by the curved arrow leading from pipe 13.

With this arrangement, the flue serves as the source of suction or region of lower pressure into which the measuring device discharges, although such source may be provided by other suitable means. However, this arrangement has the advantage that the

quantity of flue gas taken as a sample is constant and independent of the flue draft. Furthermore, with this arrangement, the fan or other means provided for withdrawing the gas sample and delivering the same to the measuring device, has to overcome only the resistance to flow created by said measuring device, together with the slight resistance of the piping.

The additional air providing the fluid combustion supporting medium of the present example, is supplied from a pipe 14 forming an air supply chamber, and is drawn or flows therefrom through a connecting conduit 15 to pipe 12. The air then mixes with the gas sample stream in pipe 12 and serves to maintain proper combustion in the measuring device, through which it flows with the gas sample, being finally discharged through pipe 13 into the flue.

In order to supply the desired quantity of additional air at a constant rate, a constant pressure of the proper value is maintained in supply chamber or pipe 14 by an automatic regulating device 16. This is located in a bypass pipe 17 which connects the supply chamber with the flue or region of lower pressure, the connection between pipe 17 and the flue being made through pipe 13 in common with pipe 12.

The regulating device in the present example is a self-closing valve which automatically opens in response to pressure in the direction of the flue and as shown in Fig. 2 comprises a simple disk valve member 18 which seats by its own weight on a relatively large annular seat 19 located between an inlet chamber 20 and an outlet chamber 21 of relatively large cross-sectional or passage area, the size of this valve arrangement being such that for even the smallest valve lift, the opening area of the valve opening is relatively large and presents a relatively low throttling resistance to flow. The lift of the valve disc is limited by an adjustable hand screw 22 which also serves to maintain the disc in a centered position with respect to the seat.

The load on the valve or movable pressure relief member is provided by the weight of said valve or member itself, although it may be provided by other equivalent means, and is constant. Hence a constant difference in pressure must exist between the chambers on opposite sides of the valve member since the latter is free to move and to automatically adjust the passage area until its weight is balanced by this pressure difference. The difference in pressure on the opposite sides of said member, and hence between the air supply chamber and the flue, is thus always equal to the constant load. Because of the large area or carrying capacity of the regulating device, no perceptible error in regulation takes place even

with small movement of the valve member with respect to the valve seat.

The regulating device thus operates to maintain a constant difference in pressure between the air supply chamber and the source of suction or lower pressure, and this pressure difference is such that the desired flow of additional air is effected through the measuring device. To establish the proper pressure in the air supply chamber to provide this pressure difference, the air supply chamber is connected with its source of supply, which in this case is the atmospheric air through an inlet conduit 23 in which is provided a restricted passage or throttling means, such as an orifice 24.

A second restricted passage or throttling means between the air supply chamber 14 and the measuring device is provided, as indicated by an orifice at 25. This is provided to compensate for the opening resistance of the regulating device 16 so that the resistance to flow in pipes 12 and 17, which provide substantially parallel and duplicate connections between the air supply chamber and the source of suction or region of lower pressure, are equalized. In the present example the throttling device 25 is located between the air supply chamber and pipe 12, although it may be located at any suitable point. However, the present location does not introduce resistance to the flow of the gas sample from the fan 8 or other means used to supply the sample.

The apparatus is adjusted in such a manner that with the least draft in the flue required for firing, the desired quantity of additional air is drawn from the air supply chamber 14 through the throttled conduit 23, with the bypass pipe 17 closed by the regulating device 16.

As soon as the chimney draft becomes greater, valve member 18 of the regulating device lifts more or less in response thereto and in accordance with the intensity of the draft, thereby maintaining a constant pressure in air supply chamber 14 and a constant quantity of additional air flow through the measuring device 9.

The operation may be further understood from the following examples: Assuming a minimum pressure difference between the flue, or region of lower pressure, and the atmosphere, or supply source of fluid combustion supporting medium, of 10 mm. of water, and that the regulating device 16 is adjusted to maintain a constant pressure drop of 8 mm. of water,—throttling device or orifice 24 must be made to effect a drop in pressure of 2 mm. of water. Assuming that the resistance to flow of the measuring device 9 is low and to be represented by a pressure drop of 2 mm. of water, then the compensating or throttling device 25 must be made to effect a pressure drop of 6 mm. of water.

If now, with this arrangement, the pressure difference increases because of increased flue draft, to a value, for example, of 40 mm. of water, regulating device 16 will move to automatically maintain a constant difference or pressure drop between air supply chamber 14 and the flue of the original 8 mm. of water. Thus between the air supply chamber 14 and the flue the same pressure difference and the same conditions of flow will exist as before through the measuring device since the pressure difference is determined by the constant load on valve 18. Throttling device 24 will then effect a pressure drop of 32 mm. of water, as the flow through it is proportionately increased. The increased flow effecting the pressure drop is bypassed through the regulating device 16 and bypass pipe 17 to the flue.

In the same manner other changes in the draft in the flue are automatically compensated for and a constant quantity of additional air or combustion supporting medium is provided for the catalytic combustion in measuring device 9.

It should be understood that while apparatus embodying the invention is more particularly adapted for catalytic measurement of flue gas in direct connection with the flue of a combustion plant, it is not limited thereto, nor to the use of air as the combustion supporting medium, and may be adapted to any catalytic gas analysis apparatus requiring a constant quantity of such medium.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. In a gas analysis apparatus, a measurement device, means for supplying thereto a constant current of gas to be analyzed, means providing a region of lower pressure to which the gas and additional fluid combustion supporting medium flow through the measurement device, and means for supplying said medium to the measurement device, said last-named means comprising a fluid supply chamber, a conduit connection between said chamber and said device, a restricted passage in said conduit, a source of fluid supply connected with said chamber, a restricted passage in said connection, and a pressure-responsive device connected between the supply chamber and the region of lower pressure for maintaining between said chamber and the region of lower pressure a constant pressure difference.

2. The combination with a catalytic gas analysis device, of means providing a region of higher pressure from which a gas sample flows to said device, means providing a second region of higher pressure from which a combustion supporting medium flows to said device, means providing a region of lower pressure, a conduit connecting the first-named higher pressure region with the region of lower pressure, said gas analysis de-

vice being located in said conduit, a second conduit connecting the second-named higher pressure region with the region of lower pressure, a pressure-regulating device in said conduit, and a conduit providing a restricted passage between said regions of higher pressure.

3. In an apparatus of the character described, the combination with a catalytic gas analysis device, of means connected with said analysis device for supplying thereto a gas current of constant volume, means providing a region of lower pressure into which said analysis device discharges, and means for supplying to said analysis device a current of fluid combustion supporting medium, said last-named means comprising a fluid supply chamber connected with said analysis device, a throttling device through which said medium is supplied to said chamber, a throttling device in the connection between the chamber and the analysis device, and a pressure-regulating device connected between said chamber and the region of lower pressure.

4. In an apparatus of the character described, the combination with a gas conductor pipe, of a conduit means connected therewith for withdrawing a gas sample therefrom and for returning the same thereto, a catalytic gas analysis device through which the gas sample is passed by said conduit means, means connected with said device for supplying a fluid combustion supporting medium thereto, together with the gas sample, and a pressure-regulating means for maintaining a constant difference in pressure between the fluid supply and the gas conductor pipe.

5. In an apparatus of the character described, the combination with a gas conductor pipe, of a conduit means connected therewith for withdrawing a gas sample therefrom and for returning the same thereto, a catalytic gas analysis device through which the gas sample is passed by said conduit means, means connected with said device for supplying a fluid combustion supporting medium thereto, together with the gas sample, and a pressure-regulating means for maintaining a constant difference in pressure between the fluid supply and the gas conductor pipe, said pressure-regulating means comprising a valve seat and a pressure movable valve member which is biased in the direction of the seat under constant load providing a valve of relatively large passage area.

6. In an apparatus of the character described, the combination with a gas conductor pipe, of a pair of conduits, one end of each of which is connected with said pipe, a supply chamber for a fluid combustion supporting medium connected with the opposite end of one of said conduits, a pressure-re-

sponsive regulating-device in said conduit, the opposite end of the other conduit being connected with the gas conductor pipe, a catalytic gas analysis device in said conduit, means for withdrawing gas from the conductor pipe located in the connection between said last-named conduit and the gas conductor pipe, a throttled conduit providing a connection between said opposite ends of said pair of conduits, and a throttled inlet conduit for said supply chamber. 10

In witness whereof, I have hereunto set my hand this 14th day of December, 1926.

DR. ROBERT EISENSCHITZ.