

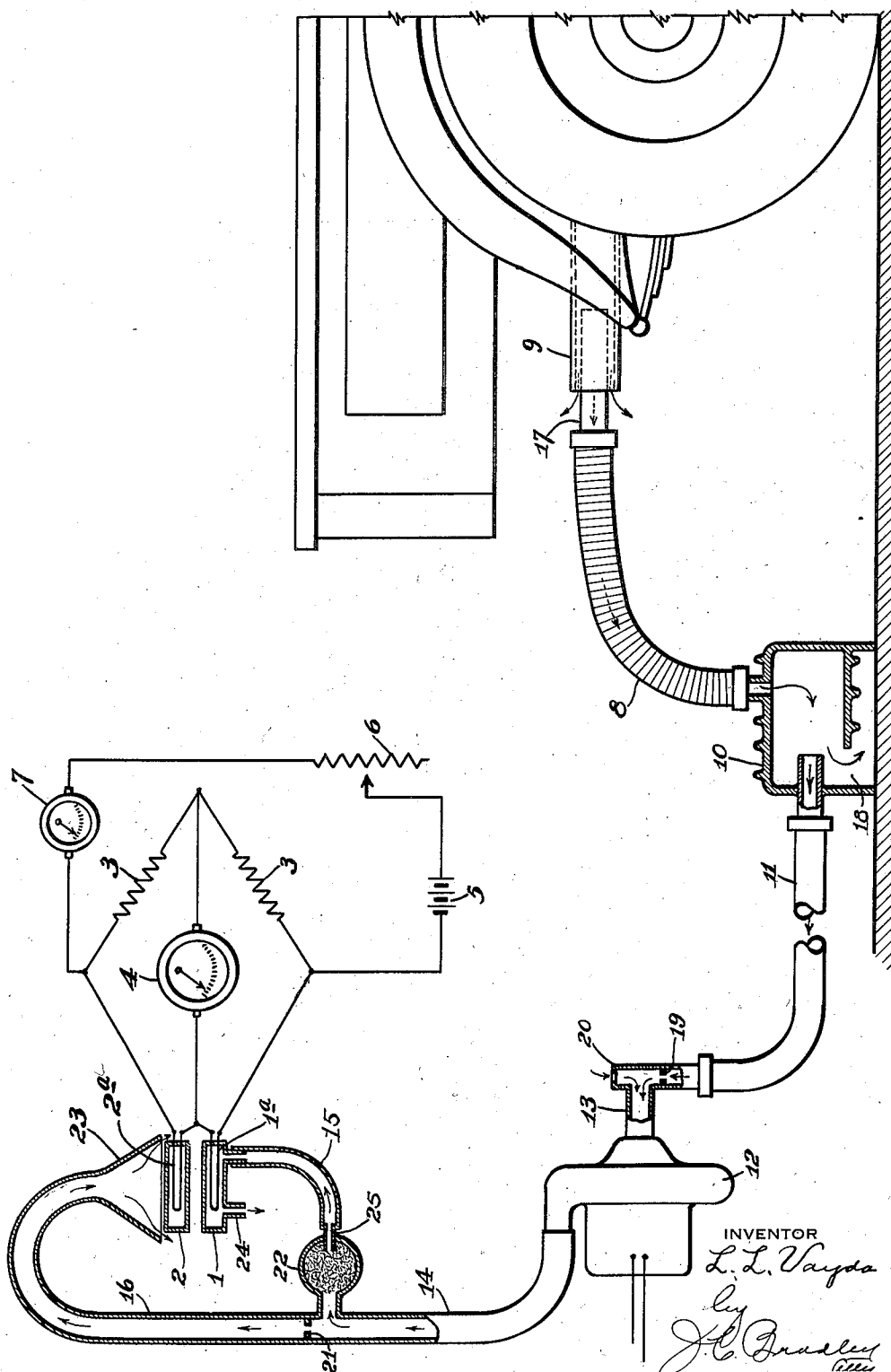
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PROCESS AND APPARATUS FOR ANALYZING GASES

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PROCESS AND APPARATUS FOR
ANALYZING GASESLouis L. Vayda, Aspinwall, Pa., assignor to Bach-
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8 Claims. (Cl. 23-255)

The invention relates to a process and apparatus for measuring, or testing, the combustible content of a gas. The gas to be analyzed, or tested, is ordinarily a gas of combustion in order to determine the efficiency of the apparatus in which the gas is consumed, and the illustration and description are directed to the use of the apparatus in this relation, but it will be understood that the invention is not limited to use in this connection and is applicable to the measurement of gases other than gases of combustion. The apparatus operates on the principle of that shown in the patent to Max Moeller No. 1,562,243, wherein the temperature of a catalyzing wire, as affected by a gas burned adjacent thereto is used as the determining factor in the gas tested. The principal objects of the invention are:

(1) The provision of a process and apparatus in which the time lag (i. e. interval ensuing between the time the gas leaves the point of sampling until the analysis is indicated) is reduced to a minimum.

(2) The provision of a process and apparatus in which the analyzing cell and accessory parts are under pressure which renders the analysis free from the effects of leaks in the system.

(3) And the provision of an apparatus, which is extremely cheap and simple, as compared with the equipment heretofore used; which requires little skill to operate, which is so compact that it may be made portable, and in which no water inlet and drain piping are necessary.

One embodiment of the apparatus employed is shown in the accompanying drawing wherein:

The figure is a diagrammatic elevation view with certain of the parts in section, the apparatus being shown as applied to the exhaust of a motor vehicle, which is regarded as the most important field of use of the apparatus, and one to which it is particularly adapted.

The analyzing unit comprises the gas analyzing chamber 1; the comparison chamber 2; the resistance elements 1a and 2a of platinum alloy or other material which acts as a catalytic agent in the operation of the device; and the Wheatstone bridge electric circuit; as shown, including the fixed resistances 3, 3, the galvanometer 4, the battery 5, the rheostat 6 and the ammeter 7, these elements together making up an apparatus well known in the art. The galvanometer 4, calibrated directly in terms of combustible to be analyzed, measures the change in potential across the Wheatstone bridge, caused by varia-

tions in the temperature of the platinum alloy wire 1a (forming one leg of the Wheatstone bridge), the temperature of which in turn is varied by burning of combustible gas along its length. Any other suitable source of current may be used in place of the battery, such as the source which supplies the current for operating the motor of the fan or blower later described. The rheostat 6 gives an adjustment so as to provide constant current as indicated by the ammeter 7.

The apparatus which cooperates with the analyzing unit, and to which the invention particularly relates comprises the flexible metallic pipe 8 for receiving the gases of combustion from the exhaust pipe 9 of a combustion motor; the pressure relief and cooling chamber 10; the flexible pipe 11; and the electric fan 12 having the suction inlet 13 and the discharge outlet 14 which latter has two branches 15 and 16, the branch 15 discharging into the analyzing chamber 1, while the branch 16 discharges over the exterior of the chambers 1 and 2.

The gases to be analyzed for combustible content, issue under pressure from the exhaust pipe 9 of the motor vehicle into which a small sampling pipe 17 carried by the end of the pipe 8 extends. A part of the exhaust gases are carried through the sampling pipe into the hose 8, which because of its composition, length and diameter dissipate heat, thereby cooling the gases to a certain extent and condensing a proportionate amount of the water vapor carried with such gases. The gases flow from the hose into the pressure relief chamber 10, being admitted in a manner to promote eddy currents which tend to separate out the carbon oil and water particles. The chamber has a large relief outlet 18 to permit the escape of surplus gas and condensed water, so that the pressure in the chamber is practically atmospheric under all conditions. The relief chamber is made relatively large and provided with fins to promote additional cooling of the gases and secure a corresponding condensation of the moisture carried by the gases.

The motor driven fan 12 creates a certain amount of suction on its inlet side which serves to draw a measured portion of the gases from the relief chamber 10 through the conduits 11 and 13, the amount of gas drawn into the fan being governed by the orifice 19 and the suction created by the fan. An air inlet orifice is also provided at 20 to admit a measured volume of atmospheric air, such air being required in order

to catalytically burn the combustible content of the gases when they are supplied through the chamber 1 as later described. The volume of diluting air as compared with the gas is preferably 10 to 12 times the volume of gas, although this may be varied under rather wide limits depending on conditions.

The mixture of gas and air entering the fan is compressed by the centrifugal action of the fan to a pressure of several inches of water (the extent of such pressure being regulated by the orifices in the outlet conduits leading from the fan as later described). In addition the design of the fan is such that in centrifugally compressing the mixture of gas and air the temperature of such mixture is raised from 40 to 60 degrees F., such rise in temperature being of importance as later pointed out. The mixture of gas and air is discharged from the conduit 14 through the two branches 15 and 16 which are provided with the orifices 25 and 21. The sizes of these orifices govern the pressure produced by the fan. The conduit 15 is provided with an enlargement 22 filled with cotton to filter the mixture of gas and air and guard the orifice 25 from clogging. The mixture supplied the cell 1 by the conduit 15 discharges through the outlet 24. The conduit 16 has a flared end 23 in opposition to the chambers 1 and 2 so that during the operation of the apparatus a stream of heated gas and air is discharged over the exteriors of the chambers. As a result the chambers are kept at a temperature such that no condensation will occur on the interior thereof and thus adversely affect the insulation in the chambers. Since the chamber 2 is employed for comparison, the external temperature condition to which this chamber is exposed should be substantially parallel to that of the chamber 1, so that it is subject to the same heating effect.

While the equipment is shown as taking a sample from the exhaust pipe of an automobile, it can be utilized as well to analyze for combustible content, any gas under pressure at the point of sampling. On the other hand, if the gas to be analyzed is under suction, the vent 18 must be closed, since no opening in the gas conveying system between the point of sampling and the analyzing equipment can be permitted. In this latter case the relief chamber may be omitted entirely since its main function, namely pressure relief, can not be used. It will always be necessary, however, to provide some means of cooling and condensing the excess moisture from the gas sample.

The advantages of the apparatus will be apparent from the foregoing. Due to the use of a large volume of gas, the movement of the gas from the point of sampling to the point of analyzing is rapid, so that the time lag is much less than in apparatus heretofore used. The handling of the large volume of gas requires relatively large pipes or orifices as compared with those heretofore used. This means that the parts are of rugged construction and the orifices of such size that danger of clogging is avoided. This is a very important consideration. The apparatus also keeps the analyzing cell and accessory parts under a substantial degree of pressure due to the compressive action of the fan so that trouble incident to leaks in the system is avoided. Any danger of condensation in the analyzing cell incident to the cooling of heated gases is avoided by the use of the heating expedient by which the mixture of gas and air are heated by the fan

and the main portion thereof is discharged over the exterior of the chambers or cells. The apparatus is also much simplified as compared with the apparatus heretofore used for the same purpose. It is readily portable and dispenses with the water inlet and drain piping heretofore employed.

What I claim is:

1. In apparatus for analyzing a gas, a Wheatstone bridge electric circuit embracing a pair of balanced fixed resistance elements, an indicator, a second pair of balanced resistance elements, one of which is a catalytic agent, a chamber surrounding each of said second pair of resistance elements, the chamber surrounding the element which is a catalytic agent having an outlet to the atmosphere and an inlet, a pumping means having a suction conduit provided with a restricting orifice leading to the supply of gas to be analyzed, a discharge conduit from the pumping means provided with two outlets, one of which leads to the atmosphere and the other of which leads to the inlet of the chamber in which the catalytic resistance element is located, and an orifice inlet from the atmosphere leading into said suction conduit, said orifice inlet from the atmosphere being of greater capacity than the orifice in the suction conduit.

2. In apparatus for analyzing a gas, a Wheatstone bridge electric circuit embracing a pair of balanced fixed resistance elements, an indicator, a second pair of balanced resistance elements, one of which is a catalytic agent, a chamber surrounding each of said second pair of resistance elements, the chamber surrounding the element which is a catalytic agent having an outlet to the atmosphere and an inlet, a pressure relief chamber, having an outlet leading to the atmosphere, to which gas to be analyzed is supplied under pressure, a fan having a suction conduit leading to said pressure relief chamber, a discharge conduit from the fan provided with two outlets, one of which leads to the atmosphere and the other of which leads to the inlet of the chamber in which the catalytic resistance element is located, and an orifice inlet from the atmosphere leading into said suction conduit.

3. In apparatus for analyzing a gas, a Wheatstone bridge electric circuit embracing a pair of balanced fixed resistance elements, an indicator, a second pair of balanced resistance elements, one of which is a catalytic agent, a chamber surrounding each of said second pair of resistance elements, the chamber surrounding the element which is a catalytic agent having an outlet to the atmosphere and an inlet, a pressure relief and cooling chamber of metal having an outlet leading to the atmosphere to which gas to be analyzed is supplied under pressure, a pumping means having a suction conduit leading to said pressure relief and cooling chamber, a discharge conduit from the pumping means provided with two outlets, one of which leads to the atmosphere and the other of which leads to the inlet of the chamber in which the catalytic resistance element is located, and an orifice inlet from the atmosphere leading into said suction conduit.

4. In apparatus for analyzing a gas, a Wheatstone bridge electric circuit embracing a pair of balanced fixed resistance elements, an indicator, a second pair of resistance elements, one of which is a catalytic agent, a chamber surrounding each of said second pair of resistance elements, the chamber surrounding the element which is a catalytic agent having an outlet to the atmosphere

and an inlet, a fan of the compression type having a suction conduit provided with a restricting orifice leading to the supply of gas to be analyzed, a discharge conduit from the fan provided with two outlets, one of which discharges to the inlet of the chamber in which the catalytic resistance element is located, and the other of which extends to a point opposite said chambers so that the mixture of gas and air is discharged over the exterior thereof, and an orifice inlet from the atmosphere leading into said suction conduit, said orifice inlet from the atmosphere being of greater capacity than the orifice in the suction conduit.

5. A process of analyzing the combustible content in gas which consists in heating a wire of catalyzing material in a chamber electrically, compressing and heating a mixture of the gas and air, supplying said mixture in two streams, one of which is directed under pressure through said chamber and the other of which is directed over the exterior thereof, and measuring the variation in the resistance of said wire as the result of the combustion in said chamber to give a determination of the combustible content in said gas.

6. A process of analyzing the combustible content in hot gas which is supplied under pressure, which consists in cooling the gas and reducing it to approximately atmospheric pressure, withdrawing a portion of said gas by suction, mixing a quantity of diluting air with said gas, compressing the mixture of gas and air, heating a wire of catalyzing material in a confined space electrically, conducting a portion of said mixture under pressure through said space and discharging the remainder thereof to the atmosphere, and measuring the variation in the resistance of said wire as the result of the combustion in said space to

give a determination of the combustible content in said gas.

7. A process of analyzing the combustible content in hot gas which is supplied under pressure, which consists in cooling the gas and reducing it to approximately atmospheric pressure, withdrawing a portion of said gas by suction, mixing a quantity of diluting air with said gas, compressing and thus heating the mixture of gas and air, heating a wire of catalyzing material in a chamber electrically, conducting a portion of said mixture under pressure through said chamber and another portion over the exterior thereof, and measuring the variation in the resistance of said wire as the result of the combustion in said chamber to give a determination of the combustible content of the gas.

8. In apparatus for analyzing a gas, a Wheatstone bridge electric circuit embracing a pair of balanced fixed resistance elements, an indicator, a second pair of balanced resistance elements, one of which is a catalytic agent, a chamber surrounding each of said second pair of resistance elements, the chamber surrounding the element which is a catalytic agent having an outlet to the atmosphere and an inlet, a pressure relief chamber, having an outlet leading to the atmosphere, to which gas to be analyzed is supplied under pressure, pumping means having a suction conduit leading to said pressure relief chamber, a discharge conduit from the pumping means provided with two outlets, one of which leads to the atmosphere and the other of which leads to the inlet of the chamber in which the catalytic resistance element is located, and an orifice inlet from the atmosphere leading into said suction conduit.

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