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METHOD AND MEANS FOR ANALYZING GASEOUS MIXTURES.

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1,333,850. Patented Mar. 16, 1920.

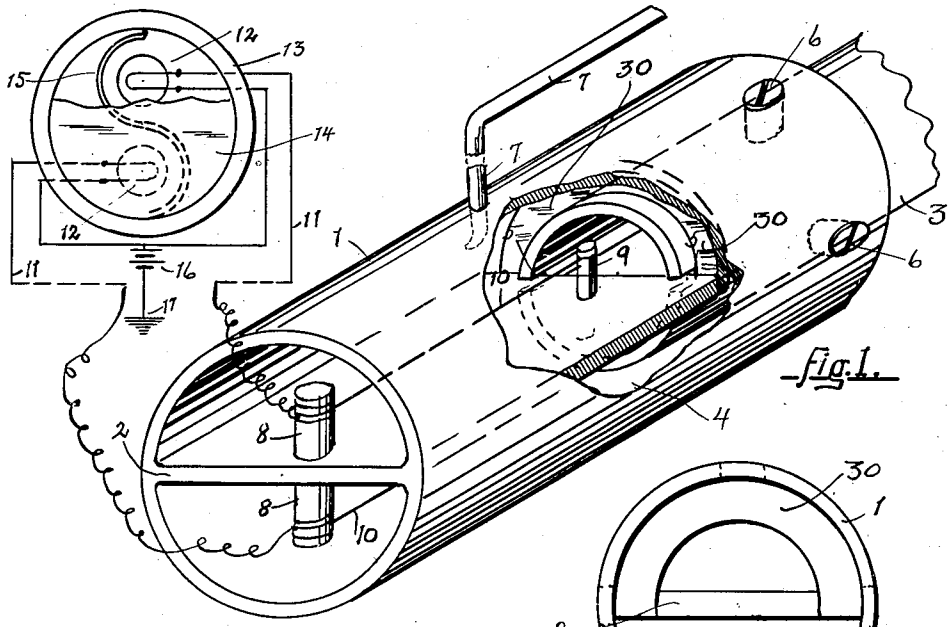


Fig. 1.

Fig. 3.

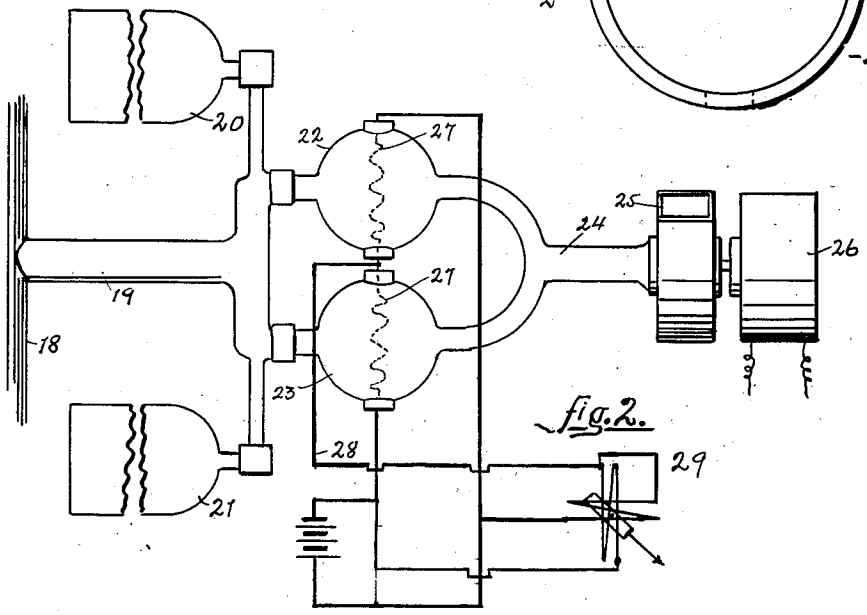


Fig. 2.

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UNITED STATES PATENT OFFICE.

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METHOD AND MEANS FOR ANALYZING GASEOUS MIXTURES.

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Application filed July 3, 1919. Serial No. 308,497.

To all whom it may concern:

Be it known that I, ABSALOM M. KENNEDY, a citizen of the United States, and a resident of the town of Cloverdale, county of Montgomery, State of Alabama, have invented certain new and useful Improvements in Methods and Means for Analyzing Gaseous Mixtures, of which this is a specification, reference being had to the accompanying drawing, forming part hereof.

The invention relates to the immediate determination of constituents of gaseous mixtures had at or very shortly after such mixtures are formed rather than to the more deliberate and necessarily postponed methods of analysis heretofore used. The object of the invention is to provide novel, simple and efficient methods and means for quickly and accurately determining as and while they are being formed the constituents or some of the constituents of mixtures of gases. Within this object are the particular objects of direct and continuous analysis of exhaust fuel gases and of the exhaust gases of internal combustion engines to determine correctness of the fuel mixtures.

The drawing shows both aspects of the invention, Figure 1 being a rough or approximate apparatus intended for quick determination of quality of fuel mixture in an internal combustion engine—that of an automobile being selected for example—Fig. 3 showing a detail; while Fig. 2 shows a more elaborated and precise apparatus adapted for analysis of stack gases for any purpose.

The broad idea of the invention is to continuously withdraw a test stream of the gaseous mixture and then, after admitting to such stream either an oxidizing or reducing agent, permit or cause any excess of uncombined gaseous matter in the original stream to combine chemically with the added agent. For example, with stack gases an added quantity of oxygen or other oxidizing agency would combine with any free or uncombined combustible gas, while, evidently, if the mixture contained uncombined oxygen—that is to say if the supply of air had been too great—this uncombined oxygen would combine with an addition of hydrogen, carbon monoxid, or other suitable agent. Naturally, in order to obtain full information of the character of the mixture and of the nature of the process which has caused it I carry on simultaneously tests of two separate streams, the one with added oxygen and the other with added hydrogen, or their equivalents. The method, however, can be used to advantage merely as a one-sided test in certain cases. It is to be noted also that while peculiarly adapted for testing gaseous products of combustion the invention is not limited to such products but is generally applicable for the detection of abnormal, or abnormally large, constituents of mixtures of gases.

In the very simple device of Fig. 1, 1 is a sleeve, say of malleable cast iron, somewhat larger than the exhaust pipe of an internal combustion engine—that of an automobile, for example—having a partition 2 for a part of its length and fixed to the end of the exhaust pipe. Notches 5, 5, and studs or set screws as at 6, 6, or the like, serve to attach it to the pipe. This structure produces two separated passages through which the exhaust gases pass; through one, open at the rear, a quantity of air, warmed by contact with the hot exhaust pipe, is drawn along by the exhaust, and in the other, closed rearwardly by the division or wall 30, a small quantity of gasolene is supplied as by pipe 7, 7, from any suitable source, steady or intermittent as may be desired. The gasolene, being vaporized by the heat of the exhaust, functions to relatively enrich the mixture in the one passage, while the excess of air drawn in by the exhaust on the other side produces a lean mixture with an excess of free oxygen. The added air here serves quite as efficiently as would pure oxygen—the apparatus not being intended as an instrument of precision. From like insulated studs 8, 8, platinum wires, spirals if desired, or wires plated with platinum or otherwise carrying catalytic agents or being in themselves catalytic agents, are strung in each passage to pins as at 9 (only one shown) whereby they are grounded through the exhaust pipe. From these wires 10, 10, suitable wires are taken to branches 11, 11, of an electric circuit embracing like lamps, 12, 12, each corresponding to a d controlled by one of the wires 10, 10, and taking part of the battery (16) current; the circuit being completed by a ground at 17 to engine bed or otherwise. The lamps, being intended to indicate by relative brilliancy are con-

veniently placed in a case 13 divided by a thin partition 15 into two adjacent parts, each illuminated by one lamp, and the whole covered by a translucent medium as at 14—the relative brilliancy of illumination of the medium being easily observed.

With this apparatus, or its equivalent, on an automobile, the indicator suitably disposed, as on the dash or instrument board, the driver can tell at a glance the nature of the fuel mixture. For, if too much gasolene is being used there will be combination of the unburned gasolene with added air in the lower passage and consequent heating and increase in resistance of the wire 10 and related lamp. On the other hand, with too lean a mixture, the uncombined oxygen will combine with the added gasolene supplied by pipe 7 and cause a like effect on the other lamp circuit. The indications are, of course, not precise, but are within reasonable limits of accuracy and the device is essentially simple, inexpensive and wholly free from moving parts or complex details. A switch and a valve for controlling the current and the added gasolene are so obvious that they are not shown—their use being, in fact, optional, as the battery current and gasolene supply need not be intermittent but may function continuously.

In Fig. 3 the structure of the sleeve 1 is more clearly indicated. This sleeve is conveniently made up as a single casting and attached without machining the exhaust pipe except for the saw cuts or notches 5, 5, and these are merely suggested. The idea in point here is to have a most readily attached device capable of use with standard exhaust fittings.

The more elaborate apparatus of Fig. 2 shows a pipe from stack 18 supplying gases through a divided system of passages as in Fig. 1. Here by a suitable aspirator or exhaust fan as that at 25 driven as by motor 26 the gases are drawn through pipe 19 and in two streams through respective chambers 22, 23, joining again in pipe 24 connected to the exhausting apparatus. Containers or sources of supply as 20, 21, serve to admit to the respective streams such suitable oxidizing agents as oxygen or an equivalent, and hydrogen or an equivalent—in other words a reducing and an oxidizing agent respectively. In the test chambers are shown in dotted line spiral conductors 27, 27, which may be platinum wire, and also may be any desired catalytic agent other than this, and may be in any form of grid, mesh, or the like, though preferably so arranged as to be themselves parts of an electric circuit. The catalytic agent appears to be necessary to effect combination of uncombined matter and it is evidently desirable to employ the catalytic agent itself to indicate the increase of heat due to any combination which it may bring about. The primary phenomena produced by the combinations within the test chambers are, of course, increases in temperature, and these may be indicated by a variety of methods, but I prefer to employ an electric circuit with suitable indicating means controlled thereby and to use the resistance variation produced in the catalyzing agent as I have shown. The circuit 28, is connected with any desired type of indicator but I prefer to use that type of meter described in Patent No. 1,154,252, August 21, 1915, as it may be used with direct or alternating current and the accuracy of its readings is independent of variations of supply of current. The angular position of the pivoted armature is controlled only by the relative magnetic forces developed by the governing coils. This meter is here shown at 29 where its circuit arrangement is given and its details are set forth in the patent mentioned above.

If the containers or chambers 22, 23, were transparent direct readings might be roughly taken by comparison of the brilliancy of incandescence of the wires 27, 27, but for all practical purposes even such an approximate indicator as that of Fig. 1 is greatly superior as even there the lamp variation is greatly more than the resistance variation of the wires 10, 10; these members being relatively much longer so that a small percentage of increase in conductivity or resistance in them may cause a large variation in current through the small lamp filament.

It may be noted that under certain conditions uncombined fuel and uncombined oxygen may both coexist in the same mixture. This may be detected by taking a stream through one test chamber in comparison with air of like temperature through the other, the respective test chambers being used alternately, or, as the two uncombined gases will combine in the presence of the catalytic agent without addition of either hydrogen or oxygen, either chamber can be employed against the other chamber, air going through one and the test stream with no added element going through the other. Suitable adjustment of resistances of the control circuits is, of course, presupposed for this or any other method of testing.

It may be well to note that by oxidizing agent I mean not only oxygen but any such gas such as chlorin, etc., which will remove uncombined hydrogen from a compound or mixture. A reducing agent, also, includes not only hydrogen but such gases as carbon monoxid, etc., capable of uniting with uncombined oxygen or of taking off excess of oxygen.

Such minor instrumentalities as variable resistances needed for instrument adjustment or calibration are not considered as

parts of the invention and are not shown but will be understood as actually employed in precise determinations.

Having described my invention, what I claim is:—

1. The method of gas testing, consisting in passing a test stream of a gaseous mixture in conjunction with an added quantity of an agent capable of combining chemically with abnormal constituents of such mixture in contact with a catalytic agent arranged to bring about such combining and indicate the same by increase of its own temperature, substantially as set forth.

2. The method of gas testing, consisting in subjecting a test stream of a gaseous mixture with an added constituent of a gaseous material capable of combining chemically with abnormal constituents of said mixture to the influence of a catalytic agent arranged to control through its temperature variations an indicating apparatus, substantially as set forth.

3. The method of gas testing, consisting in drawing off continuously a test stream of a gaseous mixture, adding to such stream a gaseous material capable of chemical combination with abnormal constituents of such mixture, and directing such stream with such addition into the presence of a catalytic agent arranged to assist combination of such added material with such abnormal constituents if present, and observing the heat variations produced in said catalytic agent, substantially as set forth.

4. The method of gas testing, consisting in withdrawing in two test streams gaseous products of combustion, adding to one stream a gaseous material capable of combining chemically with unburned constituents and to the other stream a gaseous material capable of combining chemically with free oxygen, and passing such streams respectively over catalytic agents arranged to assist chemical combination and differentially operative in said streams, substantially as set forth.

5. In apparatus for testing gases, an electric circuit, an indicator controlled by said circuit, a pair of catalytic agents differentially embraced as members of said circuit relatively to said indicator, and means for passing test streams of gaseous matter over said catalytic agents respectively.

6. In apparatus for testing gases, passages arranged to take out exhaust gases in two streams, means arranged to admit additional fuel to one stream and additional air to the other, a catalytic agent embraced in an electric circuit in each passage, an electric circuit, and an indicator in said circuit controlled by differential variation of resistance of said catalytic agents.

7. In apparatus for determining character of fuel mixture supplied to internal combustion engines a divided passage through which exhaust gases may be fed, a supply of fuel for one of such passages, means arranged to supply air to the other passage, a platinum wire in each passage, an electric circuit, and an indicator in said circuit controlled by resistance variations in said platinum wires.

Witness my hand this June 26th, 1919.

ABSALOM M. KENNEDY.

Witnesses:
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ROBERT E. TROY.