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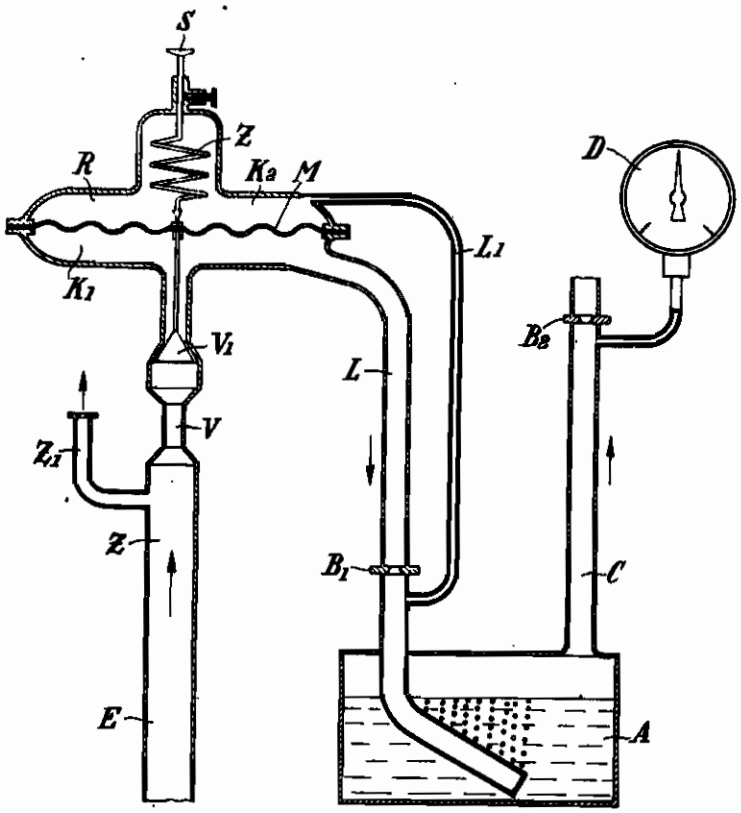

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GAS ANALYSER AND GAS ANALYSIS APPARATUS

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This invention relates to a new gas analyser for determining the proportion of one or more individual gases contained in a gas mixture. In comparison with known chemical gas analysers, the new apparatus in accordance with the invention is distinguished by the fact that it permits of a continuous and uninterrupted indication or record of the individual gas content being obtained with little or no time-lag in its response to variations. The new gas analyser may therefore be employed with particular advantage as an impulse transmitter in automatic regulators whose purpose is to maintain the content of a certain individual gas constant.

In the gas analyser according to the invention, the gas mixture to be examined, or a fraction branched off from the gas-mixture flow to be examined, is conducted through an absorption vessel in which the individual gas whose content is to be determined is absorbed. The invention is distinguished essentially by the fact that the quantity of gas mixture flowing to the absorption vessel and the quantity of residual gas flowing away from the absorption vessel are measured continuously by flow-technical method, the quotient of the two quantities giving a measure of the individual gas content sought.

The gas mixture to be examined is therefore supplied to the absorption vessel by way of a quantity regulator, so that the quantity of gas mixture flowing to the absorption vessel remains constant. A simple quantitative measurement of the gas flow leaving the absorption vessel then suffices for the determination of the content of the individual gas absorbed. If the residual gas is conducted into the atmosphere, this quantitative measurement may be carried out most simply by means of a precision pressure gauge which is connected, in front of a constriction, choke or damming aperture, to the passage conducting the residual gas away from the absorption device. Consequently, with the assistance of the new gas analyser in accordance with the invention, it is possible to cause the individual gas content to be continuously indicated and/or recorded and/or employed for regulation purpose without a time lag of any practical importance. Such lag as occurs is determined solely by the time which the gas mixture requires to pass through the absorption device.

A valve controlled by a diaphragm is preferably used for the regulation of the gas-mixture flow supplied to the absorption vessel, the connections being so arranged that the passage supplying the absorption vessel by way of the valve leads through the one diaphragm chamber and that, between the latter and the absorption vessel, a constriction or damming aperture is included beyond which a branch passage leading to the other diaphragm chamber is connected. If this regulator is connected in a comparatively narrow passage branched off from the withdrawal passage for the gas mixture to be examined and if the volumetric capacity of the diaphragm chamber traversed by the gas mixture and the volumetric capacity of the passage leading to the absorption vessel are kept as small as possible, then the quantity of the gas mixture contained in the analyser is also very small, so that the analyser operates practically without any lag. The constriction may then suitably be constituted by capillaries for which a bore of about 0.5 mm. with a length of 40 mm. is appropriate. The capacity of the absorption vessel, on the other hand, is made comparatively large, since the absorption liquid or other absorption medium has naturally to be renewed when it is approaching saturation with the individual gas to be determined. With a capacity of 5 to 10 litres of absorption liquid, the gas analyser works satisfactorily for a period sufficient for all practical purposes without renewal of the absorption medium, provided only that the volumetric capacity of the diaphragm chamber and the supply passages is kept sufficiently small.

A further very important advantage of the new analyser resides in the fact that the individual gas contents for different individual gases may be determined practically simultaneously by simply connecting a number of absorption devices for the various individual gases in series and measuring the quantity of gas leaving each absorption device.

One appropriate form of apparatus for carrying the invention into effect is illustrated in essentials in the accompanying drawing. Parts of the apparatus which do not appear to be necessary for the understanding of the essence and manner of operation of the invention have been omitted from the drawing:—

The gas mixture to be examined in respect to a certain individual gas content—for example, flue gas to be examined as to its content of carbon dioxide—enters at E into an inlet pipe Z. Whilst the main bulk of the gas mixture flows way at Z', a comparatively small part enters one chamber K, of a quantity regulator R through a constriction V. The two chambers K_1 and K_2 of regulator R are separated from each other by a diaphragm M which is loaded by an adjusting

spring F whose force can be set by means of a screw S. From the chamber K_1, the passage L leads into an absorption vessel A which is filled with an absorption medium absorbing the individual gas to be determined, for instance with potash lye in the case of the determination of carbon-dioxide content. Arranged in the passage L in front of the point of entry into the absorption vessel A is a constriction B_1 which may suitably consist of a comparatively narrow capillary, of 0.5 mm. bore and 40 mm. length, for example. Beyond the constriction B_1, branches a passage L_4 which leads into the second diaphragm chamber K_2. Consequently the pressure difference arising at the constriction B_1 acts upon the diaphragm M so that the latter sets a valve V_1 controlled by it in such fashion that the quantity of gas mixture flowing through the passage L and conducted to the absorption vessel A remains constant.

If the gas mixture contained no trace of the individual gas to be determined, then the same constant quantity of gas as is passed by the regulator R would leave the absorption vessel A, so that the same pressure difference as obtains at the constriction B_1 would be produced at a constriction B_2 provided in the discharge pipe C and consisting, suitably, of a capillary like the constriction B_1, equal passage cross-sections and equal openings in the constrictions B_1 and B_2 being assumed. This assumption is allowable, since even with other cross sections of the constrictions and passages, proportionality between the pressure differences at the constrictions would at least be obtained. If the gas mixture consisted solely of the individual gas to be determined, for example solely of carbon dioxide, then it would be absorbed without residue in the absorption vessel, for example in the potash lye. There would accordingly be no gas flow whatever through the discharge passage C, so that no pressure difference would arise at the constriction B_2. It follows that the individual gas content may be simply read off on a differential pressure gauge connected to the constriction B_2, provided that the latter is appropriately calibrated. If the residual gas is conducted away to atmosphere, then atmospheric pressure obtains beyond the constriction B_2. In this case, instead of the pressure difference arising at the said constriction B_2, the pressure obtaining in front of the same may be measured by a precision pressure gauge D connected to the passage by means of a branch pipe. The gauge D may obviously be calibrated directly in percentage proportions of the individual gas content. Instead of or in addition to the gauge D, a precision pressure recorder may be provided if recording of the individual gas content is required or a pressure regulator if regulation is to be performed in accordance with the individual gas content. A zero-point correction of the gauge D may be effected at any time by adjusting the spring-loading of the diaphragm M by means of the screw S.

A complete analysis of a gas mixture in respect of different individual gas contents may be performed by connecting several gas analysers of the above-described kind in series, say in such manner that the residual gas from the first analyser, after passing the second constriction or measuring aperture B_2, is supplied to the quantity regulator of the second analyser and so forth. It is then only necessary to provide for the absorption devices to absorb the different individual gases in succession and, apart from the last part— analyser to provide differential pressure gauges instead of the gauges D for the indication of the individual gas contents. In this fashion, for example, a complete flue gas analysis in respect of carbon dioxide, carbon monoxide and hydrogen can be carried out by connecting in series three such analysers in which the absorption media react in succession to carbon dioxide, carbon monoxide and hydrogen.

In its scope, the invention is restricted neither to employment for flue-gas analysis nor to the use of the means utilised in the above-described example. The new gas analyser may be employed for the determination of the content of any desired individual gas in any gas mixture, provided only that an absorption medium absorbing only this individual gas is employed. For instance, the new analyser may be used with particular advantage in the synthetic production of petrol for the control of the distillation gases. In place of the diaphragm regulator used in the example, use may be made of any other differential pressure regulator, for example a dipping bell differential pressure regulator or the like. The pressure difference acting upon the regulator does not need to be derived from a damming aperture, choke or other constriction, for example a constriction like a venturi-tube, but may also be derived as a dynamic or flow pressure on the one hand and a static pressure on the other hand, for example by a nozzle directed towards the flow and a nozzle directed away from the flow, or in other ways. Further constrictional forms of the new analyser may readily be devised to suit the requirements of particular cases.

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