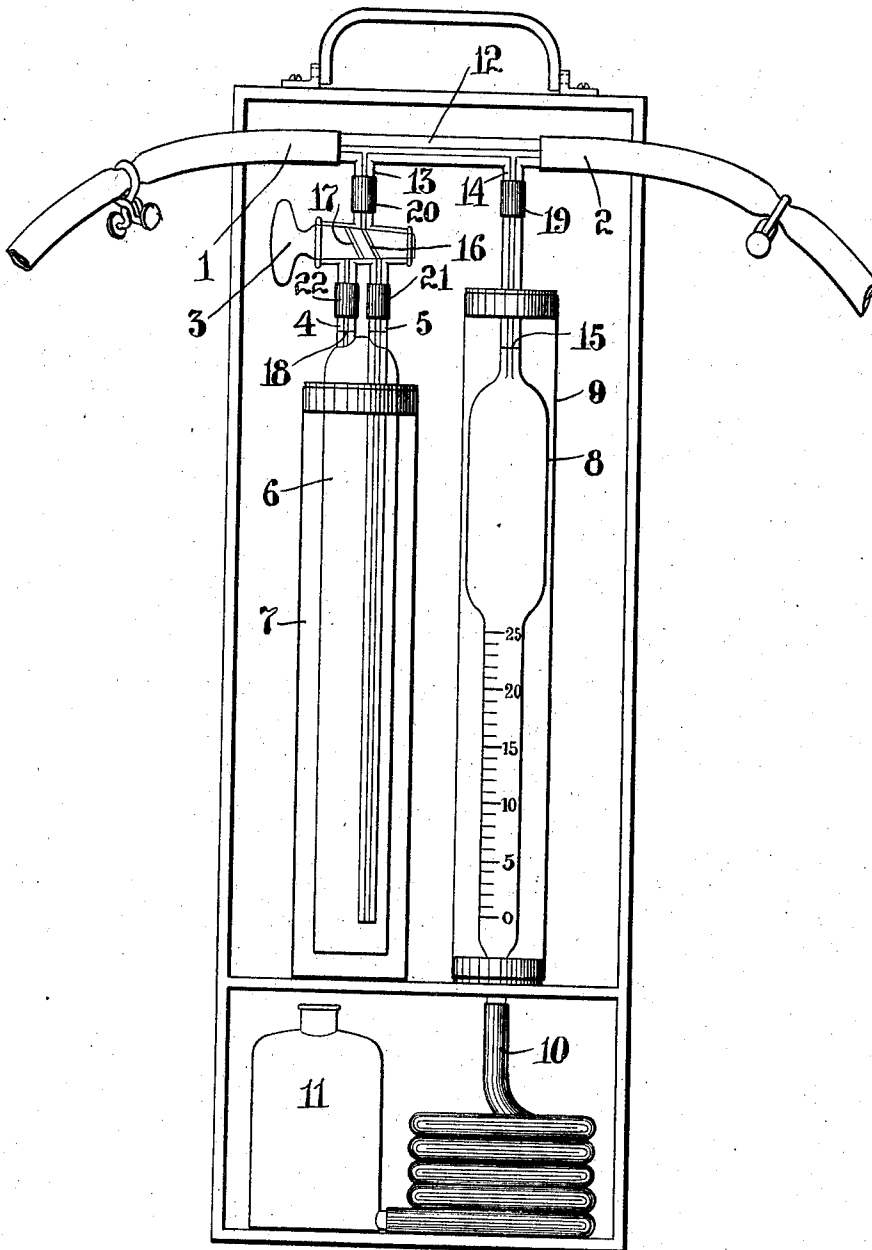


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 APPARATUS FOR GAS ANALYSIS.  
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963,484.

Patented July 5, 1910.



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# UNITED STATES PATENT OFFICE.

GODFREY M. S. TAIT, OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO GAS POWER COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

## APPARATUS FOR GAS ANALYSIS.

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Specification of Letters Patent.

Patented July 5, 1910.

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*To all whom it may concern:*

Be it known that I, GODFREY M. S. TAIT, a citizen of Great Britain, and a resident of Montclair, county of Essex, and State of New Jersey, have invented certain new and useful Apparatus for Gas Analysis, of which the following is a specification.

This invention relates to an improved apparatus for gas analysis, particularly apparatus for determining the proportion of carbon monoxid, carbon dioxid, etc., in producer gas, flue gases, exhaust gases of gas engines, etc.

The apparatus operates upon the principle of the absorption of the constituent to be estimated or measured, in a liquid reagent having selected absorption power for that particular constituent as distinguished from the other constituents of the gas treated. The apparatus comprises means for measurement of the volume of a specimen of the gas treated, before and after subjection to the said absorptive action, also means whereby the measurement of the volume of gas may be conducted rapidly and accurately, and whereby effective absorptive action of the reagent on the gas is assured.

The objects of my invention are to improve and simplify gas analyzing apparatus; to make the same strong, durable, readily portable and easily operated, and to make the same rapid and accurate in operation.

The accompanying drawing shows a side elevation of one form of apparatus embodying my invention, located within a suitable portable case.

In this drawing, 1 designates a pipe through which gas is admitted to the apparatus and which will customarily be provided with a suitable pinch cock or like valve device for controlling the flow through said pipe.

2 designates an outlet pipe also provided with a suitable pinch cock or like valve device for controlling flow.

3 designates an ordinary turn plug valve the plug of which has two ports, as herein-after described, adapted to register respectively with pipes 4 and 5 of which pipe 4 leads to a pipette 6 open at its lower end located within a liquid container 7. Pipe 5

is sealed into the top of pipette 6 and extends to near the bottom thereof, as indicated in the drawings.

8 designates a burette located within a liquid containing vessel 9, and extending through the bottom thereof and there connected by a flexible pipe 10 with a water bottle 11 which bottle may be elevated or depressed, as hereinafter described, to cause water or other suitable liquid to flow into or out of burette 8 for the purpose of drawing gas into or forcing gas out of said burette. This burette is provided with a scale by which volumes may be estimated. Pipes 1 and 2 are connected by a pipe 12, branches 13 and 14 from which lead to the valve 3 and the burette 8.

The manner of operating the apparatus is as follows: Vessel 7 and pipette 6 being filled to suitable levels (point 18 on pipe 4, for pipette 6) with a reagent for absorbing the constituent to be estimated (cuprous chlorid in the case of carbon monoxid and caustic soda in the case of carbon dioxid) and pipe 1 being connected to the source from which the gas is to be drawn and water bottle 11 being filled with water or other suitable liquid, this bottle is raised by the operator, the pinch cock of pipe 2 being open, and the plug of valve 3 in such position that pipes 4 and 5 are closed, so that the water from bottle 11 will flow through pipe 10 into burette 8 until the same is completely filled. The upper portion of this burette is a tube of such small dimensions that a slight difference in level of the water in this tube has an almost inappreciable effect upon the final results; and there is customarily a mark 15 on this tube indicating the level to which it should be filled at this time, that is to say, the level at which the burette is considered "full". The pinch cock in pipe 2 is then closed and the pinch cock in pipe 1 opened and the water bottle 11 is lowered, so that the water flows from burette 8 back into said bottle, and in so doing draws from pipe 1 and the source of supply to which it is connected, a sample of the gas, the one constituent of which is to be estimated. The liquid is allowed to flow down into bottle 11 in this way until the level of the liquid in burette 8 is at the zero mark on the scale of said burette. The

pinch cock in pipe 1 is then closed and the operator turns the plug of valve 3 into the position shown in the drawing, in which position its port 16 connects branch 3 and pipe 5. The water bottle 11 is then elevated again, so forcing the gas in the burette 8 out through pipes 14, 12 and 13 into pipe 5 and so downward into pipette 6, the gas bubbling up through the liquid in such pipette and so being subjected effectively to the absorptive action of such liquid on the constituent of the gas which that liquid is capable of absorbing or dissolving. The water from bottle 11 is allowed to flow into the burette 8 until such water has risen to the mark 15 above mentioned. The liquid displaced from pipette 6 by the gas forced over into such pipette as just described, goes outward into vessel 7. The water having risen in burette 8 to mark 15 as described, the plug of valve 3 is turned so that its port 16 no longer connects pipes 13 and 5 and instead its port 17 connects pipes 4 and 13, and the water bottle 11 is again lowered so that the liquid flows back from burette 8 into bottle 11, thus drawing over the gas from pipette 6 into burette 8 and drawing back liquid from vessel 7 into pipette 6. This is continued until the liquid in pipette 6 is at its original level (usually indicated by a mark 18 on pipe 4). It will then be found that the liquid in burette 8 is above the zero mark of that burette by an amount corresponding to the proportion of the sample of the gas which has been absorbed by the liquid in pipette 6. The proportion which the volume represented by the difference between any two marks on the scale of burette 8 with reference to the total volume of burette 8 up to mark 15, being known, or having been previously determined by calibration; the reading of the scale of burette 8 gives directly and accurately the proportion which the gas absorbed bears to the total volume of the sample treated.

If desired, before taking a reading of the water level in burette 8 as just described, the gas may be passed back and forth between burette 8 and pipette 6 a number of times, by alternately raising and lowering bottle 11 and alternately reversing the position of the plug of valve 3. But in general it will not be necessary to do this, because, owing to the small diameter of pipe 5, the gas passes up through the liquid in pipette 6 in relatively small bubbles and so is exposed quite efficiently to the absorptive action of the liquid in said pipette.

The proportion of gas absorbed having been measured as just described, the plug of valve 3 is turned so that neither of its ports 16 and 17 are in registry with pipe 13, and the pinch cock of pipe 1 being still closed and pinch cock of pipe 2 being now open, bottle 11 is raised and thereby the water is

caused to fill burette 8, so expelling the sample of gas tested. The apparatus is then ready for the treatment of another sample.

Where it is desired to determine more than one of the constituents of the gas, there will usually be two or more of these apparatus connected in series, the pipettes of the several apparatus each containing a liquid suitable for selective absorption of the particular constituent which that apparatus is to determine; and when a sample of gas has been passed through one of these apparatus and the proportion of one constituent measured as just described, and when the remaining gas is forced out of the burette 8 of that apparatus as just described, it will be drawn into the next apparatus of the series and the proportion of another constituent estimated in the same manner, and so on. This use of a plurality of similar gas analysis apparatus in series, each containing absorbing liquid suitable for the estimation of a particular constituent of the gas treated, is a common expedient in the analysis of gas, and I therefore do not deem it necessary to illustrate here a plurality of these gas analysis apparatus so connected in series.

It will be observed that the apparatus is exceedingly simple, easily operated, and portable, and that the readings given are direct. It will also be observed that it is susceptible of construction so as to be quite durable, there being no delicate rigid connection between the measuring burette and the gas absorption pipette as is the case in certain forms of gas analysis apparatus now in use. In general the connections between the burette and pipe 12 will be made by a flexible rubber coupling 19 and connections between valve 3 and pipe 12, and between pipes 4 and 5 and valve 3, will be made by similar flexible couplings, 20, 21 and 22. Vessel 9 constitutes a water jacket for the burette 8.

What I claim is:—

1. An apparatus for gas analysis comprising in combination a liquid-containing vessel provided with volume-measuring means and adapted for connection to means for varying the volume of liquid within it, an absorption chamber provided with means for introducing gas into liquid therein and with a separate connection for drawing off the gas and means for connecting either said gas introducing means or said gas withdrawing connection at will to said liquid-containing vessel.

2. An apparatus for gas analysis comprising in combination a liquid-containing vessel provided with volume-measuring means, means for varying the volume of liquid within said vessel, an absorption chamber provided with means for introducing gas into liquid therein and with a separate connection for drawing off the gas and means

for connecting either said gas introducing means or said gas withdrawing connection at will to said liquid-containing vessel.

3. An apparatus for gas analysis comprising in combination a liquid-containing vessel and a gas absorption vessel, said absorption vessel provided with means for introducing gas into liquid therein and with a separate connection for drawing off the gas, means for connecting said vessels comprising a valve adapted to connect such liquid-containing vessel with either the gas introducing means or the gas withdrawing connection or to close connection between said vessels, and means connected to said liquid-containing vessel for introducing liquid thereinto or withdrawing it therefrom.

4. An apparatus for gas analysis comprising in combination a burette provided with a volume-measuring scale, a gas absorption pipette provided with gas introducing means arranged to conduct gas to the lower portion of said pipette, and provided in its upper part with a gas discharge connection, means for connecting the upper portion of said burette with the gas introducing means and the gas discharge connection of said pipette comprising a three way valve, and means for varying the level of liquid in said burette.

5. An apparatus for gas analysis comprising in combination a burette provided with volume measuring means, an absorption pipette comprising a gas introducing pipe adapted to introduce gas near the lower portion of said pipette, and provided also with a gas discharge connection, a cross pipe and a three way valve for connecting said burette and the gas introducing pipe and gas discharge connection of the pipette.

6. An apparatus for gas analysis comprising in combination a burette provided with volume-measuring means, an absorption pi-

pette comprising a gas introducing pipe adapted to introduce gas near the lower portion of said pipette, and provided also with a gas discharge connection, a cross pipe and a three way valve for connecting said burette and the gas introducing pipe and gas discharge connection of the pipette and means for varying the height of liquid in said burette comprising a liquid containing-vessel adjustable vertically and a connection therefrom to said burette.

7. An apparatus for gas analysis comprising in combination a burette provided with volume-measuring means, an absorption pipette comprising a gas introducing pipe adapted to introduce gas near the lower portion of said pipette, and provided also with a gas discharge connection, a cross pipe and a three way valve for connecting said burette and the gas introducing pipe and gas discharge connection of the pipette, and a liquid receiving vessel surrounding said pipette and adapted to receive liquid overflowing therefrom.

8. An apparatus for gas analysis comprising in combination a burette provided with volume-measuring means, an absorption pipette comprising a gas introducing pipe adapted to introduce gas near the lower portion of said pipette, and provided also with a gas discharge connection, a cross pipe and a three way valve for connecting said burette and the gas introducing pipe and gas discharge connection of the pipette, and flexible couplings between the burette, pipette and the connecting means.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

GODFREY M. S. TAIT.

Witnesses:

H. M. MARBLE,

FRANK E. RAFFMAN.