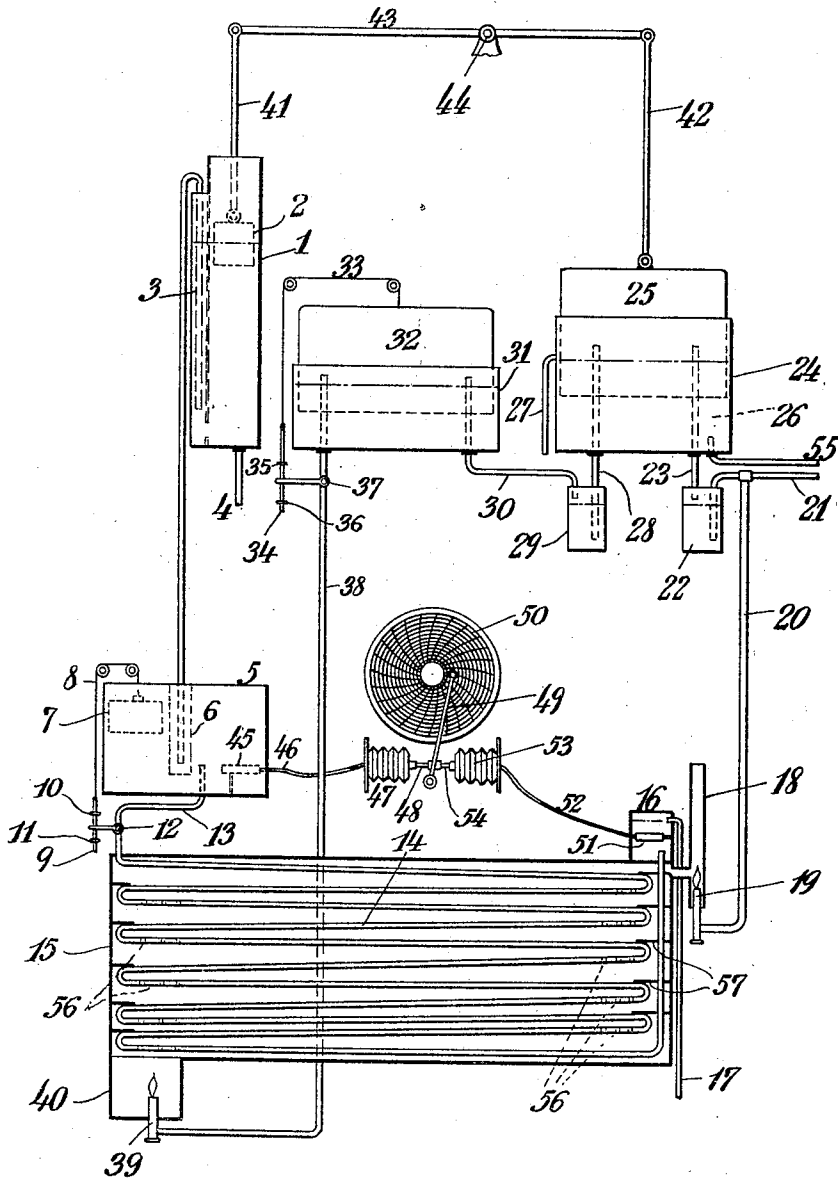


G. G. CREWSON.
METHOD OF AND APPARATUS FOR TESTING GASES.
APPLICATION FILED JULY 3, 1916.

1,245,688.

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George Grant Crewson. *Inventor*
By his Attorneys
Martin & Luche

UNITED STATES PATENT OFFICE.

GEORGE G. CREWSON, OF TOTTENVILLE, NEW YORK, ASSIGNOR TO THE ROESSLER & HASSLACHER CHEMICAL CO., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

METHOD OF AND APPARATUS FOR TESTING GASES.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, GEORGE GRANT CREWSON, a citizen of the United States of America, and resident of Tottenville, in the county of Richmond and State of New York, have invented certain new and useful Improvements in Methods of and Apparatus for Testing Gases, of which the following is a specification.

The object of this invention is to provide a means whereby a person unskilled in making such tests may readily carry out the testing of a sample of any gas to ascertain its heating value; another object is to provide those who frequently have to make recurrent tests upon samples of the same gas, with a ready means of continuously accomplishing this purpose without being compelled to rearrange the details in each test.

In the accompanying drawing, I have diagrammatically illustrated, by way of example, an arrangement of apparatus which I preferably use in the carrying out of my new method.

The apparatus comprises an actuating tank 1 in which a float 2 is adapted to rise until siphon 3 is filled, the water entering tank 1 preferably under constant pressure through pipe 4. Siphon 3 is connected at its lower end with water chamber 5, the discharge end of the siphon reaching somewhat below the middle of the chamber and being surrounded by a cylinder 6 extending somewhat below the discharge end of the siphon. Within chamber 5 is mounted a float 7 connected by a rope 8 with a weight 9, said weight having an upper contact 10 and a lower one 11 to open or close, respectively, a valve 12 in pipe 13 by contacting with and moving the handle of said valve 12. Pipe 13 connects chamber 5 with a calorimeter coil 14, which is a conductor capable of being heated and made preferably in the form of a hollow, metallic flat ribbon, said coil being incased within the closed heating chamber 15. Calorimeter coil 14 discharges into water chamber 16, preferably mounted on top of chamber 15, pipe 17 conducting the water from the water chamber 16 into the sewer. Chamber 15 is provided with a chimney 18, a burner 19 in said chimney being fed with gas through pipe 20, branching off from main gas pipe 21. Main gas pipe 21 leads to a closed vessel 22, acting as a liquid seal, and therefore

partly filled with water; a pipe 23 leads therefrom to a gas pump 24, provided with a movable bell 25, in a water seal 26 regulated by overflow pipe 27. A pipe 28 leads from gas pump 24 to another liquid seal 29, from which a pipe 30 leads to a water sealed gas holder 31 provided with a movable bell 32; rope 33 attached to bell 32 at one end and carrying a weight 34 at the other actuates contacts 35 and 36, which open or close respectively, a valve 37 in pipe 38 connecting the gas holder 31 with the burner 39, in the hood 40, located below the calorimeter coil 14 in the heating chamber 15, said hood 40 being preferably located in a diametrically opposite position to water chamber 16 and arranged to discharge the products of combustion from burner 39 into heating chamber 15.

Float 2 in tank 1, and bell 25 are preferably pivotally connected to holding rods 41 and 42 respectively, which in turn are also pivotally connected to lever 43 carried by support 44.

Water chamber 5 is provided with a thermometer bulb 45, connected by means of tube 46, of small caliber, with a diaphragm box 47; said bulb 45, tube 46 and diaphragm box 47 are filled with a suitable medium, such as air or other medium expanding and contracting under the influence of heat and cold, so that said medium exerts pressure against the diaphragm of box 47, a rod 48 attached to said diaphragm acting upon an indicator arm 49 carrying a pencil or pen, in the usual way, adapted to write on a paper indicator 50. Water-chamber 16, at the discharge end of calorimeter coil 14 is also provided with a thermometer bulb 51 connected by means of tube 52, with a diaphragm box 53 carrying a rod 54, all parts of this latter arrangement corresponding in dimensions with those connected with water-chamber 5; as shown rods 54 and 48 both act simultaneously on indicator arm 49. A pipe 55 is provided to supply water to gas pump 24.

The width of the ribbon calorimeter coil 14 preferably extends from wall to wall of chamber 15 so that the products of combustion from burner 39 can pass through chamber 15 only by means of passageways 56, provided in the lower branch of each bend of coil 14, the baffle-plates 57 at the end of the upper branch at each bend of the coil,

compelling a zig-zag path for said combustion gases through the successive series of passageways 56, said gases being finally discharged into chimney 18.

5 The method of measuring the heating value of the produced gases will now be described, reference being had to the apparatus described above as one example of how my method of testing the heating value of gas
10 may be carried on to obtain a satisfactory effect.

Tank 1 is filled with water through pipe 4 from a suitable source (not shown) until it reaches the highest level of siphon 3. The
15 entering water raises float 2 and holding rod 41 acts on lever 43, pushing its left-hand end upward and lowering its right-hand end to which gas bell 25 is attached by means of rod 42; gas bell 25 is now lifted as the water
20 in tank 1 begins to overflow, through siphon 3 coming into action, and tank 1 being emptied; as bell 25 rises it draws in a definite volume of gas from main pipe 21, through seal 22. As the water continuously enters
25 tank 1 through pipe 4, float 2 is raised again, and gas bell 25 is lowered again, whereby the volume of gas, previously drawn in by the upward move of the gas bell, is now forced through pipe 28, into the seal 29 from
30 which it passes through pipe 30, into gas holder 31, gas bell 32 moving upwardly owing to the pressure of the gas. From gas holder 31 the gas passes through pipe 38 to burner 39 where it is ignited to give up its
35 heat to the calorimeter coil 14, filled with the water from tank 1, by means of the connection through siphon 3, water chamber 5 and pipe 13. At the moment the water enters chamber 5 its temperature is relatively low and the medium in bulb 45, tube
40 46 and diaphragm box 47 soon assumes the same temperature. The heat generated by the gas burned by burner 39 is given off to the calorimeter coil and its water content.
45 Passageways 56 through coil 14, and baffle plates 57 force the combustion gases in a zig-zag path through the heating chamber as described, whereby the gases are compelled to travel a sufficient distance so that the coil,
50 and consequently the water therein, will absorb the heat of the combustion gases. It is evident that the water and the hot gases act on each other according to the well-known counter current principle and that therefore
55 the water passing through the lowest winding of the coil is exposed to the greatest heat of the combustion gases, and therefore shows a considerable increase in temperature. At the discharge end of coil 14 the temperature
60 is measured by thermometer bulb 51, preferably located in the water-chamber 16 as described, the volume of the medium in bulb 51 increasing considerably owing to the high temperature of the water and exerting pressure
65 sure on the diaphragm of box 53 which

causes rod 54 to actuate indicator arm 49. The pressure exerted by rod 54 on indicator arm 49 is, of course, influenced by the increase or decrease of the volume of the medium in bulb 45 in water-chamber 5 owing to variations in the temperature of the water passing through said water-chamber, so that the curve marked by indicator arm 49 on indicator sheet 50, always represents the difference in the temperature of the water in the
70 two chambers for a certain period of time. To secure a good combustion, an artificial draft may be created, if desired, by maintaining a flame on burner 19.

Certain precautions should be taken in the
80 construction and operation of the apparatus to avoid errors in the results. For instance the diameter of siphon 3 must be considerably greater than that of inlet pipe 4 in order that the variation in the quantity of
85 water flowing into tank 1 during the siphoning will introduce only a negligible error, unless water pressure variations are excessive. To avoid this latter, a tank, serving as water source, may be provided, in which
90 either by overflow or float valve, a constant volume of water is maintained so that a constant quantity of water may be supplied therefrom to tank 1.

The supply of a constant volume of water
95 to tank 1 for the operation of float 2 and the consequent operation of the gas bell 25 should take place at such a rate that the quantity of gas discharged from gas holder 31 in a constant flow for a unit of time or
100 over a period covered by the cycle of water and gas measurement described above, will be just equal to that quantity forced into gas holder 31, during the period of discharge
10 from gas pump 24.

In case the flow of gas holder 31 over a given cycle is slightly less than the flow into the same over that cycle the bell 32 of the gas holder 31 will rise to a higher point, causing the contact 35 on the weight 34 to strike the
11 rod of valve 37, thus automatically opening said valve slightly to allow a larger flow from holder 31. Similarly if the flow from said holder is too large, the bell 32 will cause valve 37 to close automatically by means of
12 contact 36, the flow of gas thus being lessened; it is evident that the gas from holder 31 will thus flow to the burner 39, at a continuously even rate.

Similarly the flow of water from tank 1
13 through tank 5 into calorimeter coil 14 is automatically regulated on the same principle; if the flow from tank 5 is too large or too small, the valve 12 will be accordingly closed or opened respectively by contacts
14 11 and 10 acting on the stem valve 12. It is clear, therefore, from the foregoing, that the quantity of water, passing through the calorimeter and the quantity of gas burned always have the same ratio regardless of the
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rate of flow of either and that the difference in temperature between the water entering and leaving the calorimeter vessel, as registered by arm 49 on indicator sheet 50, is therefore the measure of the heat value of the gas.

It is obvious that the method of measuring the heat value of gases by operating for instance an apparatus as described has considerable advantages over the methods usually applied up to now, for it permits the use of a convenient means for maintaining the ratio between the quantity of gas and the quantity of absorbing medium; its accuracy is entirely independent of atmospheric conditions and it is not easily affected by limited amounts of solid impurities or dirt in either the gas or the water, nor by reasonable changes in water pressure or its temperature; furthermore the simple method of operation permits its use without expert attention and admits of constructing the apparatus in a rugged strong design so that it can be easily adapted, for factory use, to any kind of combustible gas.

I do not restrict myself in either the arrangement of parts or in the construction thereof, to the details shown and described, further than the scope of the appended claims demands.

I claim:

1. A method of testing the heating value of gas, consisting in drawing gas from a suitable source, continuously burning the gas, conveying the heat of combustion to water constantly flowing in a continuous stream through means capable of being heated, passing the hot combustion gases over said means in a direction opposite that of the water and simultaneously measuring the difference in the temperature of the water before receiving and after receiving the heat conveyed thereto.

2. A method of testing the heating value of gas, consisting in furnishing a supply of water, intermittently drawing a constant volume of water from said supply, drawing a constant volume of the gas from a suitable source by means controlled by the water supply, continuously burning the gas, conveying the heat of combustion to water constantly flowing in a continuous stream through means capable of being heated, passing the hot products of combustion in a direction opposite that of the water over said means and simultaneously measuring the difference in the temperature of the water before receiving and after receiving the heat conveyed thereto.

3. A method of testing the heating value of gas, consisting in supplying a constant flow of water, drawing the gas from a suitable source by means controlled by the water supply, continuously burning the gas, regulating its supply at an even rate during the

combustion, conveying the heat of combustion to a continuous stream of the water through means capable of being heated, controlling the gas supply, passing the hot gases in a direction opposite that of the water and simultaneously measuring the difference in the temperature of the water before receiving and after receiving the heat conveyed thereto.

4. A method of testing the heating value of gas consisting in continuously burning the gas, conveying the heat of combustion to water constantly flowing in a direction opposite the course of the combustion gases, simultaneously measuring the difference in the temperature of the water before receiving and after receiving the heat conveyed thereto, and supplying in each cycle of operations constant volumes of water and of gas.

5. A method of testing the heating value of gas consisting in continuously burning the gas, conveying the heat of combustion to water constantly flowing in a direction opposite the course of the combustion gases through a calorimeter vessel, simultaneously measuring the difference in the temperature of the water before entering and after leaving the calorimeter vessel, controlling the supply of the gas to be tested by the flow of the water, subsequently absorbing the heat produced by the burned gas and maintaining a constant ratio between the volume of gas to be burned and the quantity of water absorbing the heat of combustion.

6. The method of testing the heating value of gases and rendering visible the measure of said heating value, consisting in automatically drawing in the sample of gas to be tested by means actuated by flowing water, subsequently conducting this water through a calorimeter vessel, burning the gas continuously below said calorimeter vessel, conveying the heat of combustion to the water flowing through said calorimeter vessel, simultaneously measuring the difference in the temperature of the water before entering and after leaving the calorimeter vessel and graphically indicating said difference in temperature by means controlled by said temperature changes.

7. In an apparatus for testing the heating value of gas, the combination of a gas pump, a gas holder, an actuating tank, a calorimeter vessel, connections between the gas pump and the gas holder, operatively arranged connections between the actuating tank and the gas pump, connections between the actuating tank and the calorimeter vessel, a gas-conducting pipe leading from the gas holder and terminating in a burner below the calorimeter vessel and a thermometer both at the inlet and at the outlet of the calorimeter vessel.

8. In an apparatus for testing the heating value of gas, the combination of a gas pump, a gas holder, an actuating tank, a calorimeter vessel, a seal between the gas supply pipe and the entrance pipe to the gas pump, a connection between the gas pump and the gas holder, a seal in said connection, operatively arranged connections between the actuating tank and the gas pump, connections between the actuating tank and the calorimeter vessel, a gas-conducting pipe leading from the gas holder and terminating in a burner below the calorimeter vessel and a thermometer both at the inlet and at the outlet of the calorimeter vessel.

9. In an apparatus for testing the heating value of gas, the combination of a gas pump, a gas holder, a movable bell in the gas holder, an actuating tank, a calorimeter vessel, a seal interposed between the gas-supply pipe and the entrance pipe to the gas pump, a connection between the gas pump and the gas holder, a seal in said connection, operatively arranged connections between the actuating tank and gas pump, connections between the actuating tank and the calorimeter vessel, a gas-conducting pipe leading from the gas holder and terminating as a burner below the calorimeter vessel, a regulating valve interposed in said gas conducting pipe between its open end and the gas holder, an operatively arranged connection between the aforesaid regulating valve and the movable bell of the gas holder, and a thermometer both at the inlet and at the outlet of the calorimeter vessel.

10. In an apparatus for testing the heating value of gas, the combination of a gas pump, a gas holder, an actuating tank, a water-chamber, a calorimeter vessel, connections between the gas pump and the gas holder, a water supply pipe entering the actuating tank, a float within said actuating tank operatively connected with the gas pump, a siphon connection between the actuating tank and the water chamber, a connection between the latter and the calorimeter vessel, an automatic regulating device interposed in the last named connection, a gas conducting pipe leading from the gas holder and terminating in a burner below the calorimeter vessel, and a thermometer in the

water-chamber and at the outlet of the calorimeter vessel.

11. In an apparatus for testing the heating value of gas, the combination of a gas pump, a gas holder, an actuating tank, a water-chamber, a calorimeter vessel, connections between the gas pump and the gas holder, a water supply pipe entering the actuating tank, a float within said actuating tank operatively connected with the gas pump, a siphon connection between the actuating tank and the water-chamber, a connection between the water-chamber and the calorimeter vessel, a valve interposed in said connection between the water chamber and the calorimeter vessel, a connection between said valve and the water-chamber, a gas conducting pipe leading from the gas holder and terminating in a burner below the calorimeter vessel, and a thermometer both in the water chamber and at the outlet of the calorimeter vessel.

12. In an apparatus for testing the heating value of gas, the combination of a gas pump, a gas holder, an actuating tank, a water-chamber, a calorimeter vessel comprising a flat metallic tube, folded into a coil and provided with passageways in the lower branch of each bend of the coil, said coil being incased to form a zigzag path for traveling gases, connections between the gas pump and the gas holder, a water supply pipe entering the actuating tank, a float within said actuating tank operatively connected with the gas pump, a siphon connection between the actuating tank and the water-chamber, a connection between the latter and the coil, an automatic regulating device interposed in said last named connection, a gas conducting pipe leading from the gas holder and terminating in a burner below the metal coil, and a thermometer both in the water-chamber and at the outlet of the coil.

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

GEORGE G. CREWSON.

Witnesses:

MARION E. SULLIVAN,
LILLIAN D. WOOD.