

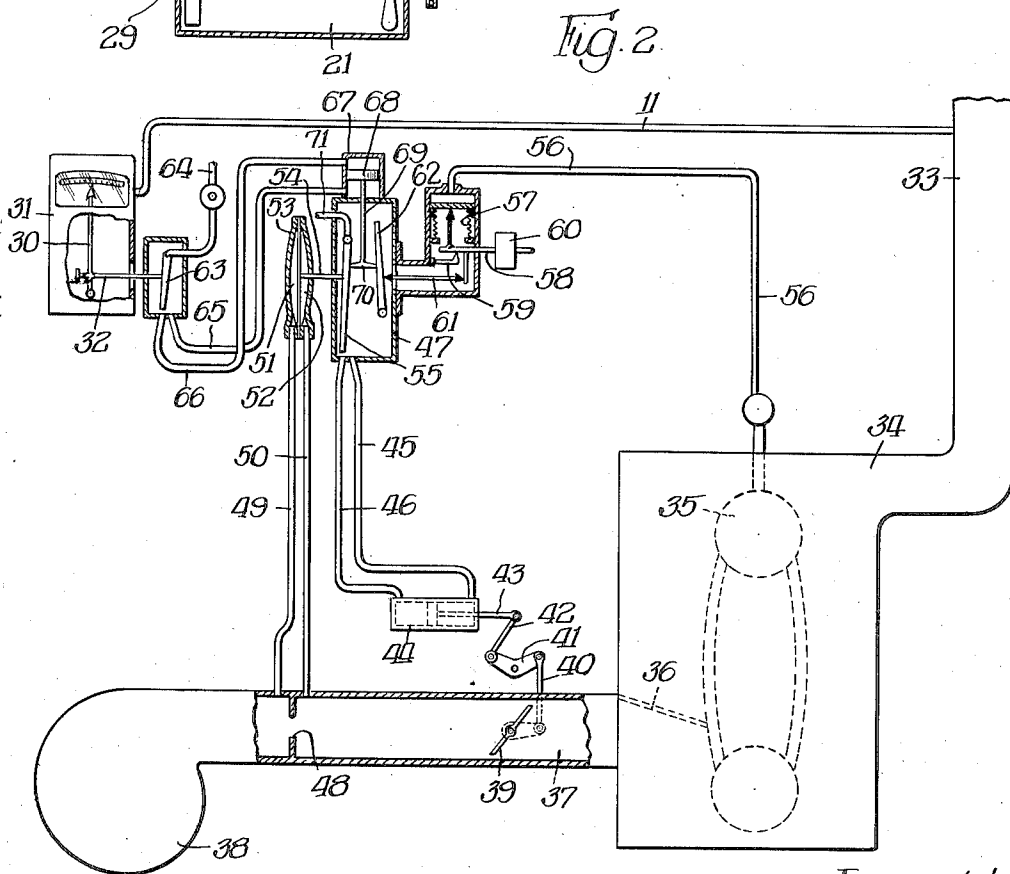
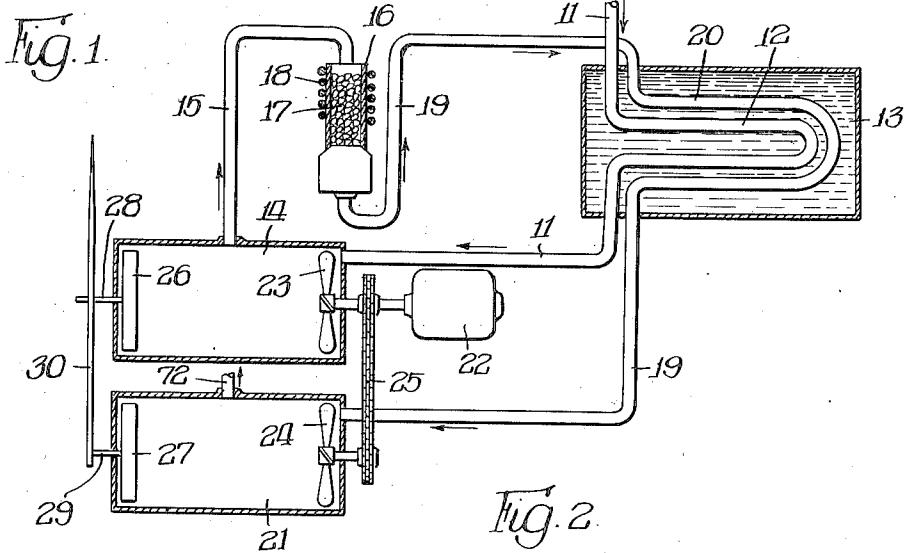
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A. J. BOYNTON

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METHOD FOR DETERMINING THE OXYGEN CONTENT OF GASES

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Inventor:
Arthur J. Boynton,
By *William H. Byrnes & Knights*
attys.

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METHOD FOR DETERMINING THE OXYGEN
CONTENT OF GASESArthur J. Boynton, Chicago, Ill., assignor to H. A.
Brassert & Company, Chicago, Ill., a corpora-
tion of IllinoisOriginal application April 18, 1932, Serial No.
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5 Claims. (Cl. 23—232)

This invention relates to a new and improved method and apparatus for determining the oxygen content of gases. This application is a division of my copending application Serial No. 605,817, filed April 18, 1932.

The means which I employ for determining the oxygen present is based on the difference in specific gravity between the ordinary gases such as nitrogen and oxygen on the one hand, and carbon dioxide on the other. The weights of nitrogen and oxygen are approximately equal to that of air, while the weight of carbon dioxide is 1.53 times that of air. Instruments for determining the density of any given gas as compared with that of air are now available. Of these I prefer to use an instrument of the type in which the specific gravities of two gases are compared by imparting a whirling motion to the gas in order to obtain a substantial force as a means of measuring its specific gravity.

In carrying out my invention, I put a sample of gas successively through two chambers, with a treatment between the time of exit from the first chamber and the entrance to the second. In order to have the gas conditions with respect to temperature identical during the passage through the two chambers, I provide water cooled passages through which the gas sample is led prior to its introduction to the first and also the second chamber. These passages are parallel to each other and cooled by the same body of water so as to produce an identical temperature at the time of entering the two chambers. I also interpose in the gas circuit after the point of exit from the first chamber, a heated chamber filled with carbon on which any excess oxygen in the flue gases unites with the carbon to become carbon dioxide.

Any means of heating the carbon containing chamber may be used. I do not limit myself to carbon but may use sulphur or other reagent capable of uniting with oxygen to form a heavy gas. I prefer to use an electric heating element which I apply to the end of the chamber at which the gas enters. I provide a further unheated section of this chamber which will be heated so far as will be necessary by combustion of carbon. This system of initial heating ensures completion of combustion at a low temperature and a corresponding conversion of all burned carbon to carbon dioxide.

Various types of boiler combustion control are now in use in which the boiler steam pressure and the volume of gas passing to the fires are control factors. For example, the control acts

to increase air flow when the steam pressure drops and vice versa. A control based on the oxygen content of the flue gas may be added as a third element in the furnace operation and this control may be connected between the air and steam controls to modify their interaction.

It is an object of the present invention to provide a new and improved method for determining the oxygen content of gases.

It is also an object to provide an apparatus for oxygen determination suitable for use in a furnace combustion control with the oxygen content of the waste gases as a control factor.

It is an additional object to provide an improved apparatus for carrying out my oxygen determining method.

It is a further object to provide a method for determining oxygen content in which the gas is tested before and after chemical treatment to bring the oxygen content into combination to form a heavier gas.

Other and further objects will appear as the description proceeds.

I have shown somewhat diagrammatically a preferred embodiment of my invention in the accompanying drawing, in which—

Figure 1 is a view, partly in section, showing the oxygen recording means; and

Figure 2 is a diagrammatic view, also partly in section, showing the oxygen recording means applied to a furnace control.

The oxygen recording construction shown in Figure 1 comprises a pipe 11 which has a coil 12 in the water box 13. This pipe 11 leads from the water box 13 to the drum 14 of the density determining instrument. The pipe 15 leads from a median portion of the drum 14 to the carbon chamber 16. This chamber 16 is shown as containing carbon 17 and as provided with the heating coil 18. The pipe 19 leads from the carbon chamber 16, this pipe having a coil 20 located in the water box 13. Pipe 19 continues from the water box to the second drum 21 of the density determining instrument.

The electric motor 22 directly drives the fan 23 located in the drum 14, and drives the fan 24 located in the drum 21 by means of a chain drive 25. This drive is such that the two fans are driven at an exactly uniform rate of speed. The drum 14 contains an impulse wheel 26 and the drum 21 contains an exactly similar impulse wheel 27. These two wheels have their shafts 28 and 29 connected to a pointer 30.

In the furnace control construction shown in Figure 2, the density determining instrument 31

is shown with the pointer 30 and the secondary pointer 32 connected to the pointer 30. The pipe 11 connects the stack 33 with the density determining instrument. This stack 33 leads from a furnace chamber 34 containing a boiler 35 and a grate 36. The air passage 37 leads into the furnace below the grate 36. Air is furnished to the passage 37 through a blower 38. The pivoted damper 39 is located in the passage 37 and this damper is actuated through link 40, bell crank lever 41 and link 42, which latter link is connected to the piston rod 43 operating in the cylinder 44. The opposite ends of the cylinder 44 are connected by pipes 45 and 46 with the control device 47.

The passage 37 is provided with a restricted orifice 48. The pipes 49 and 50 lead from the passage 37 on opposite sides of the orifice 48 and are connected to chambers 51 and 52 located on opposite sides of the diaphragm 53. The push rod 54 is connected to diaphragm 53 and extends into the control device 47 engaging the swinging nozzle 55. The pipe 56 conducts steam pressure from the boiler 35 to the syphon diaphragm 57. The lower side of the diaphragm 57 is engaged by the arm 58 pivotally supported at 59 and counterweighted by the weight 60. The rod 61 actuated by the arm 58 extends into the control device 47 and engages an intermediate arm 62. The pointer or lever 32 of the density determining instrument 31 engages a swinging nozzle 63 which is furnished with oil under pressure through the pipe connection 64. This nozzle 63 is adapted to discharge oil under pressure against the open ends of the adjacent pipes 65 and 66. These pipes 65 and 66 discharge into cylinder 67 on opposite sides of the piston 68. The piston rod 69 is connected to piston 68 and is in turn connected to a ratio slider 70, one end of which engages the intermediate lever 62 and the other end of which engages the swinging nozzle 55 in the control instrument 47. This nozzle 55 is furnished with oil under pressure through the pipe connection 71.

In the operation of the density determining instrument shown in detail in Figure 1, the sample of the flue gases from the stack 33 is led through pipe 11 to the water box 13. This box serves to reduce the temperature of the gases to that of the water contained therein. It will be understood that the drawing is diagrammatic and sufficient coils 12 may be used to insure adequate temperature change at this point. From the water box 13 the gas passes to the drum 14 where the fan 23 blows the gas against the impulse wheel 26. The exhaust gas from the drum 14 passes through pipe 15 to the carbon chamber 16. Here the heated carbon combines with the oxygen to form carbon dioxide. The carbon dioxide containing gas is passed through pipe 19 and through coil 20 in the water box 13. Here the gas temperature is restored to that which it had when passing through the box previously through coil 12.

The gas passes on then through pipe 19 to the drum 21 where the fan 24 causes it to blow against the impulse wheel 27. The gas discharged from the drum 21 passes out through pipe 72. It will be seen that since the fans 23 and 24 are identical and the gases in the drum are at a uniform temperature, the effect of the gases upon the impulse wheels 26 and 27 is proportional to the density of the gases. The pointer 30 is connected to the impulse wheel shafts 28 and 29 in such manner that the torque imparted to the wheel 26 will act in a direction opposite to that imparted to the

wheel 27. It will be understood that these wheels 26 and 27 do not rotate freely, but merely impart the impressed torque to the pointer 30 which will move according to the algebraic sum of the torques imparted to the two wheels. Movement of this pointer is consequently a measure of the density difference between the gases as they reach the two chambers. Since this density difference depends solely upon the increase in density caused by the combination of the oxygen with the carbon, the movement of the pointer may be readily calibrated to show the oxygen content of the gas as it reaches the instrument.

In the form of construction shown in Figure 2, a secondary control based on the oxygen content of the flue gases is superposed on a usual type of furnace control. The furnace control device 47 is primarily acted upon on the one hand by the quantity of air furnished the furnace chamber 34. This quantity of air is measured by the differential pressure on either side of the orifice 48, which differential pressure acting through pipes 49 and 50 is directed on opposite sides of the diaphragm 53. It will be apparent, therefore, that the thrust given nozzle 55 by the rod 54 will vary as the volume of air furnished to the furnace varies.

The other control is based on the steam pressure in the boiler 35, this acting through the syphon diaphragm 57 against the counterweighted arm 58. The counterweight may be adjusted to give a proper proportional movement to the rod 61 so that acting through the intermediate movement 62 a thrust is transmitted to the swinging nozzle 55 opposite to the thrust transmitted by the rod 54. It is apparent that these opposing thrusts may be so adjusted as to maintain any desired ratio between air input to the furnace and steam pressure in the boiler. The additional control based on the oxygen in the stack is transmitted to the control device 47 by means of the ratio slider 70. This slide moves up and down in accordance with the oxygen content of the flue gas and by its position between the nozzle 55 and the intermediate lever 62 it thus directly affects the thrust transmitted through lever 62 and hence the reaction between the thrust due to steam pressure and that due to air volume is modified by location of the slider.

While I have described a preferred method of carrying out my invention, it will be obvious to those conversant with the art that other means than those described may be used for carrying out the principles of my invention.

For instance, the formation of carbon dioxide is not limited to the use of carbon only, as certain catalysts, carbides of metals, or other compounds containing carbon, could be used in the formation of carbon dioxide. Other changes and modifications may be made to meet varying conditions and requirements and I contemplate such changes and modifications as come within the spirit and scope of the appended claims.

I claim:

1. The method, suitable for use in furnace combustion control, of determining the oxygen content in a mixture of gases, which comprises determining the density of the mixture, causing oxygen content of the mixture to combine with carbon to form carbon dioxide by passing the mixture over heated carbon, determining the density of the modified gas mixture, and comparing the original and modified densities.

2. The method of continuously determining the oxygen content in a mixture of gases, which

comprises causing a flow of the mixture, determining the density of the mixture at one point in the flow, modifying the composition of the gases at a further point in the flow by causing
5 a combination of the contained oxygen with carbon to produce carbon dioxide, and determining the density of the modified gas at another point in the flow.

3. The method of continuously determining the
10 oxygen content in a mixture of gases, which comprises causing a flow of the mixture, causing a torque dependent upon the gas density at one point in the flow, modifying the composition of the gases at a further point in the flow by causing
15 ing a combination of the contained oxygen with carbon which combination produces a gas materially heavier than the original oxygen, causing a second torque dependent upon the density of the modified gas, and comparing said torques.

20 4. The method of continuously determining the oxygen content in a mixture of gases, which comprises causing a flow of the mixture, causing a torque dependent upon the gas density at one

point in the flow, modifying the composition of the gases at a further point in the flow by causing a combination of the contained oxygen with carbon to produce carbon dioxide, a gas materially heavier than the original oxygen, causing a
5 second torque dependent upon the density of the modified gas, and comparing said torques continuously throughout the flow.

5. The method of continuously determining the oxygen content in a mixture of gases, which
10 comprises causing a flow of the mixture, causing a torque dependent upon the gas density at one point in the flow, modifying the composition of the gases at a further point in the flow by causing
15 an additional element to produce a gas materially heavier than the original oxygen, causing a second torque dependent upon the density of the modified gas, and causing said torques to react
20 against each other and measuring the resultant of the reaction.

ARTHUR J. BOYNTON.