Feb. 7, 1928. 1,658,391

F. D. POTTER

COMBUSTION GAS SAMPLING APPARATUS

Filed July 11, 1923 2 Sheets-Sheet 1

FIG 1

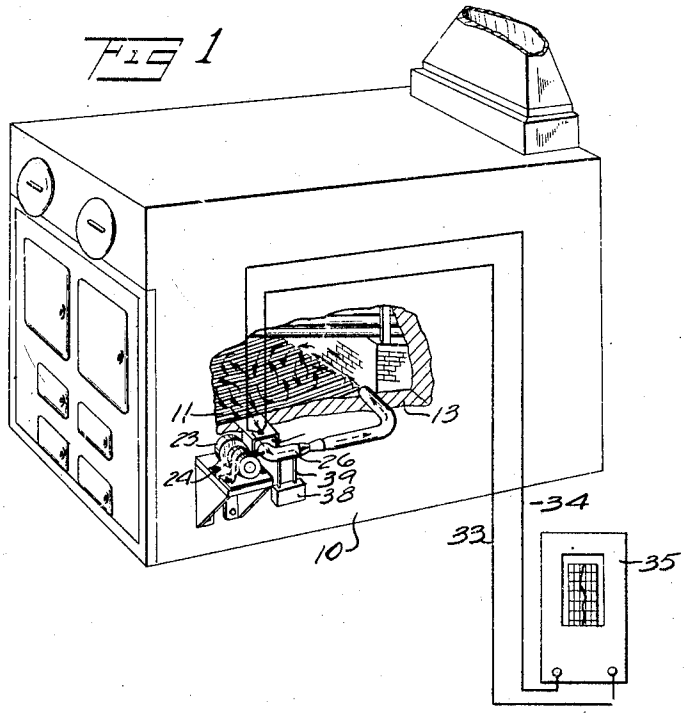
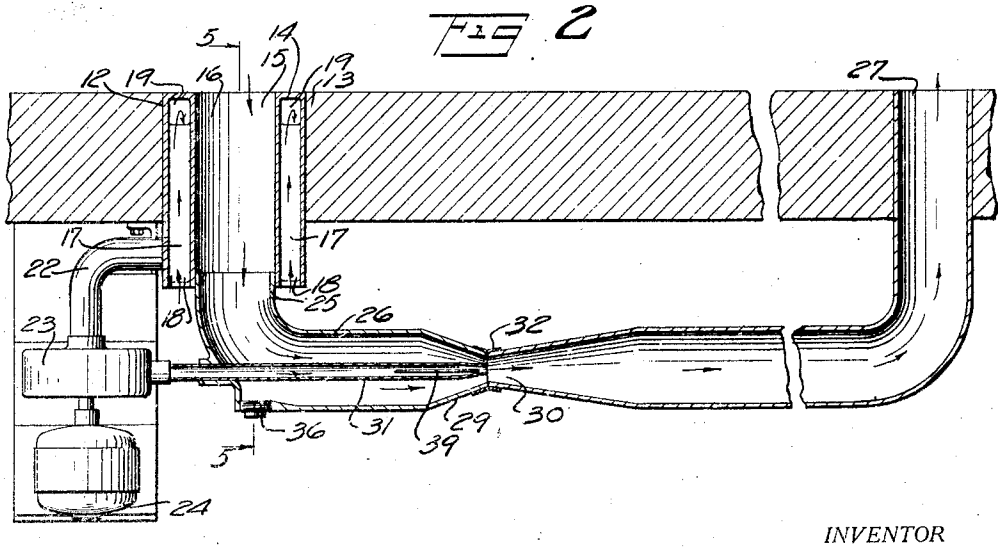


FIG 2



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Filed July 11, 1923 2 Sheets-Sheet 2

FIG 3

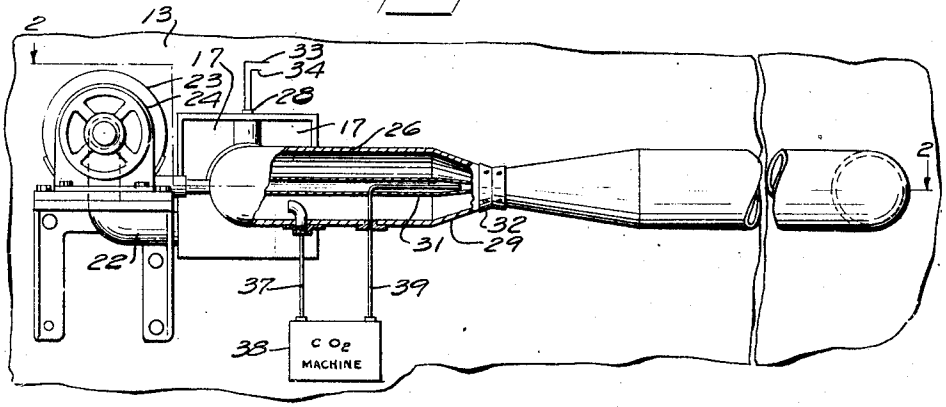


FIG 4

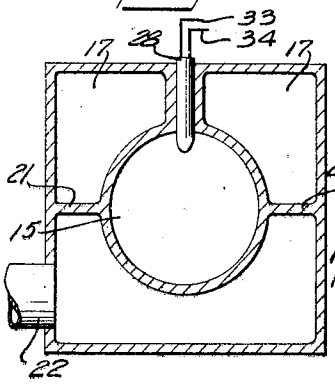


FIG 5

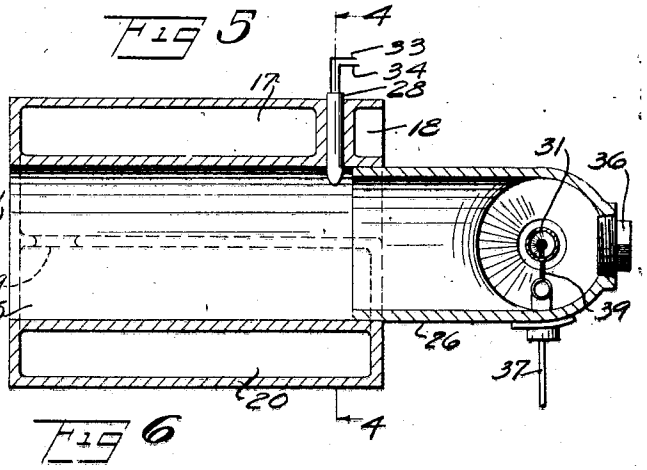


FIG 6

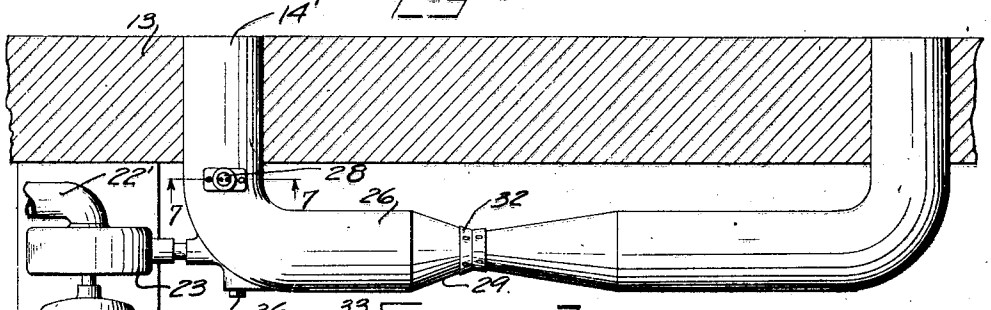
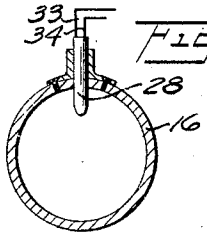


FIG 7



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Patented Feb. 7, 1928. 1,658,391

UNITED STATES PATENT OFFICE.

FREDERICK D. POTTER, OF LINDEN, NEW JERSEY, ASSIGNOR TO COMBUSTION CONTROL COMPANY, INC., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

COMBUSTION-GAS-SAMPLING APPARATUS.

Application filed July 11, 1923. Serial No. 650,804.

My invention relates to apparatus for taking a continuous representative sample of gases from the combustion chamber of a furnace or other combustion apparatus, which can be used for obtaining an indication of temperature corresponding to the furnace temperature, and for other purposes.

An embodiment of the invention is illustrated herein in connection with a coal-fired boiler furnace, but the invention is applicable to combustion apparatus generally, and to the use of any desired fuel.

According to the present invention hot gases from the combustion chamber are drawn past a temperature taking device, as a thermocouple in its protecting tube, which is located away and thereby protected from destruction by the furnace temperature, but serves to give the average temperature of the gases, from which the actual temperature of the furnace itself can be determined by adding a differential figure. Such differential figure can be determined, for example, with a particular boiler firebox or other combustion apparatus, and a particular sort of fuel, by taking a series of visual pyrometer furnace readings contemporaneously with a similar series of pyrometer readings, and noting the average difference, which is to be added to pyrometer readings to give actual furnace temperatures. This correction can be made automatically in various ways, as by offset charts, changes in the construction of recorder arm, and the like.

The gases drawn from the furnace are preferably returned thereto with additional air mixed therewith, thereby providing a circulation which assists combustion and secures improved admixture of furnace gases, which in turn assists in supplying well averaged samples of gas to be taken past the thermocouple.

The gas conduit preferably extends outside the furnace where it can be easily taken care of, and the cooling effect of the atmosphere serves to keep the apparatus from getting unduly hot.

With the preferred form of apparatus the gas circulation past the thermocouple is secured by an air blast so located and arranged as to provide a suction to withdraw the furnace gases and a blast to return same with additional air to the furnace and preferably, though not necessarily, the incoming air to be used for suction and blast is made use of to precool the gas passage between the furnace and the region where the thermocouple or equivalent temperature taking device is located.

Other objects and features of my invention will appear in connection with the following description. In the drawings, Fig. 1 is a part perspective and part diagrammatical view showing a boiler furnace equipped with a gas sampling apparatus in accordance with my invention.

Fig. 2 is an enlarged horizontal sectional view of the gas conduit and related parts shown in Fig. 1.

Fig. 3 is a side view of the parts shown in horizontal section in Fig. 2.

Fig. 4 is a section on line 4—4, Fig. 5.

Fig. 5 is a section on line 5—5, Fig. 2.

Fig. 6 is a view similar to Fig. 2, and showing a modification wherein the incoming air is not made use of for conduit cooling, and Fig. 7 is a cross-section on line 7—7, Fig. 6.

Reference character 10 designates a combustion apparatus, a coal-fired boiler furnace with grate bars 11 being shown for purposes of illustration. An opening 12 is made through the side wall 13 of furnace 10 for the reception of a heat resistant gas passage member 14, which is preferably made of a high refractory tile, adapted to stand up under high heat. Member 14 is provided with the hot gas passage 15 and is preferably molded or otherwise formed to provide an air cooling jacket about the walls 16 of gas passage 15. In the form shown, the incoming air enters passages 17, 17 formed in the upper part of member 14, coming in through ports 18, 18, and traveling in the direction of the arrows on Fig. 2, passes downwardly through openings 19, 19, and thence passes forwardly through the passage 20 provided below the preferably horizontal partition walls or baffles 21, 21 to the intake pipe 22 of the fan or blower 23. Blower 23, which may be driven from any convenient source of power, is here shown as actuated from the electric motor 24.

Gas passage 15, in the form shown, communicates with and forms part of a conduit, the remainder 25 whereof is preferably provided as a pipe 26 of cast iron or heat resisting metallic alloy, which may

discharge into the gas column at any convenient point, as at the stack or back of the furnace bridge wall, but preferably its outlet 27 is directed back into the furnace as shown. The air discharge from blower 23 is arranged to discharge within the gas conduit 25 in such a manner as to bring the hot gases through passage 15 in member 14 past the thermocouple of equivalent temperature taking device 28 and out through the outlet 27. In the form shown, which is deemed the preferable form, the pipe 26 is contracted at 29 to form a Venturi passage 30 and the air supply pipe 31 is arranged at about the region of greatest contraction of the Venturi passage. In this way sufficient suction is created to draw furnace gases through passage 15 and past thermocouple 28.

The discharge of the furnace gases with the added air into the combustion chamber at 27 sets up a circulation within the combustion chamber, as indicated by the arrows on Fig. 1, thereby assisting combustion and keeping the gases in a state of thorough admixture. With this arrangement, the gases drawn past the thermocouple are thoroughly mixed and are closely representative of the average gas temperature conditions within the combustion chamber.

The form of Figs. 6 and 7 is like that already described, except that the member 14′ is not air cooled and the air intake pipe 22′ takes air directly from the atmosphere. The thermocouple 28 may be connected up by its lead wires 33, 34 to any suitable indicating device, such, for example, as the automatic recording instrument 35 indicated in Fig. 1. As already stated, while the instrument 35 may be arranged as usual to indicate temperatures of the thermocouple and the corrective addition made in any desired way, it is preferable to have the addition made automatically, as by offset charts, special construction of recorder arm, or in other ways, so as to show furnace temperatures directly.

The parts may be made up in any suitable way to facilitate assembly. I have shown pipe 26 parted at the region of smallest diameter and secured together by sleeve 32.

A plugged opening 36 is preferably placed in the conduit opposite passage 15 leading from the furnace to admit a slice bar for pushing out any material which may become lodged in or adhering to the member 14.

The forced circulation described may be utilized for various purposes. For example, it may be used to supply samples of gas for determination of CO_2 content by Orsat or other suitable apparatus. One way in which this can be done is illustrated in Fig. 3 where a pipe 37 is taken from the conduit near the inlet end and leads to a CO_2 apparatus indicated diagrammatically at 38. The pipe 39 from the CO_2 apparatus 38 is led into the air blast pipe 31, and being pointed in the same direction as pipe 31, suction is produced drawing the gases of combustion through the CO_2 apparatus. Such arrangement is particularly useful where it is desired to secure a series of temperature determinations and contemporaneously to take the corresponding CO_2 content of the combustion gases.

The embodiment illustrated is for purposes of illustration only and for affording an understanding of ways in which the invention can be carried out. Modifications and changes may be resorted to within the scope of my claims.

I claim:

1. The combination with a combustion apparatus comprising a combustion chamber, of a conduit communicating with said combustion apparatus at both ends, the inlet thereof being from the combustion chamber, power means for creating a circulation of combustion gases through said conduit, means for taking the temperature of the combustion gases between the combustion chamber and the circulating means, a CO_2 machine, an intake pipe therefor extending into said conduit and having its inlet directed against the gas stream, and an outlet pipe therefor extending into said conduit and having its outlet directed with the flow of the gas stream in said conduit.

2. The combination with a combustion apparatus comprising a combustion chamber of a conduit communicating with the combustion chamber at both ends and having the intake end provided with an air passage extending about the conduit of air blast means for causing a flow of combustion gases through the conduit, said air blast means being arranged to take the air for the air blast through the said air passages, whereby the intake portion of the conduit is air cooled.

3. The combination with a combustion apparatus comprising a combustion chamber of a conduit communicating at both ends with the combustion chamber, and air blast means for inducing a flow of combustion gases through the conduit, said air blast means being arranged to take the air from around a portion of the conduit, whereby said portion of the conduit is cooled.

4. The combination with a combustion apparatus comprising a combustion chamber of a conduit communicating at both ends with the combustion chamber, an air blast pipe discharging longitudinally of said conduit between its ends, whereby combustion gases are drawn out of the combustion chamber and discharged with additional air back into the combustion chamber, thereby circulating and thoroughly mixing the gases in the com-

bustion chamber and assuring that the gases entering the conduit are representative of average temperature, etc., conditions within the combustion chamber, and temperature taking means exposed to the gases in the conduit between the entry end thereof and the air pipe.

5. The combination with a boiler and its combustion chamber of a conduit pipe extending out into the atmosphere and communicating at both ends with the combustion chamber, said conduit having a portion of reduced diameter to thereby form a venturi, a pipe within said conduit and having its discharge end in the Venturi portion of the conduit, a blower for forcing a blast of air through said pipe to thereby create a circulation of combustion gases within the chamber and to commingle additional air therewith, the portion of the conduit issuing from the combustion chamber being provided with an air jacket, and means for taking the intake air for said blower through said air jacket, whereby such portion of the conduit is air cooled.

6. The combination with a combustion apparatus comprising a combustion chamber of a conduit leading out of and back into the combustion apparatus of air blast means discharging substantially axially of said conduit for causing a flow of combustion gases through the conduit, and a suction pipe so arranged that a suction is provided therein by said air blast, said suction pipe having its opposite end arranged to receive furnace gases from the conduit and supply same to testing apparatus such as a CO_2 machine.

7. The combination with a furnace having a combustion chamber of a conduit communicating with the combustion chamber at both ends and having an intermediate substantially Venturi section of reduced diameter, a blower having a discharge pipe extending into said conduit substantially axially thereof at the Venturi portion thereof, whereby a flow of furnace gases is created through said conduit and the gases are returned to the combustion chamber with additional air, temperature taking means for taking temperature of gases passing through said conduit at a point between the combustion chamber and the air blast discharge, a testing apparatus such as a CO_2 machine, said testing apparatus having intake connection in the neighborhood of the intake portion of the conduit and having a suction outlet pipe connected therewith, said suction pipe extending into the conduit in the neighborhood of the air discharge pipe, whereby furnace gases are passed through the CO_2 machine and are adapted to have their CO_2 content taken simultaneously with the taking of temperatures of the gases passing through the conduit.

In testimony whereof, I have signed my name hereto.

FREDERICK D. POTTER.