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METHOD AND BOILER PLANT FOR COMBUSTION OF FUELS

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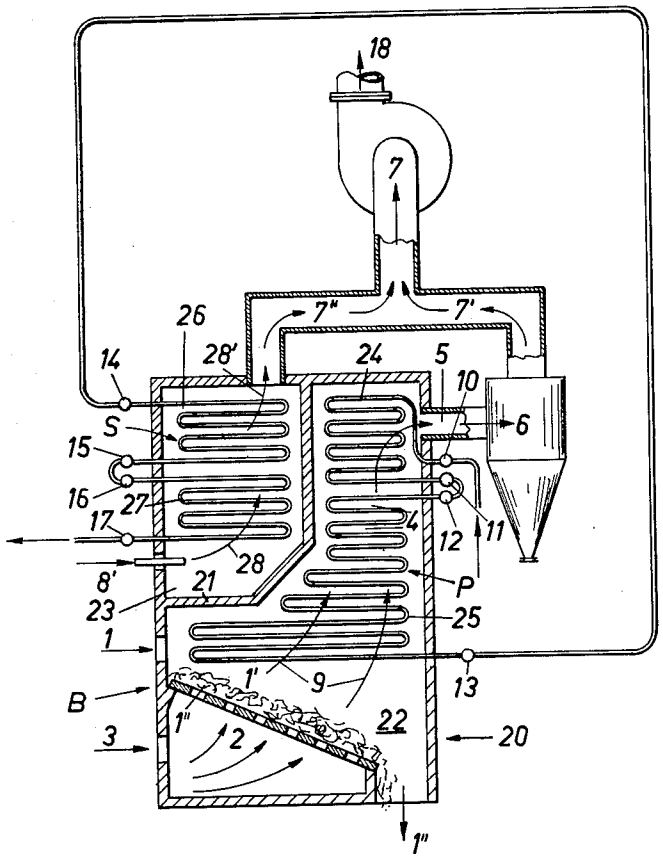

INVENTORS
Richard Tanner
Karl Perl
BY Hans Bauer
Werner W. Kleeman
Their Attorney

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METHOD AND BOILER PLANT FOR COMBUSTION OF FUELS

Richard Tanner, Zurich, Karl Perl, Thalwil, and Hans Bauer, Oberengstringen, Switzerland, assignors to Von Roll A.G., Gerlafingen, Switzerland, a corporation of Switzerland

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9 Claims. (Cl. 122—2)

The subject invention is a continuation-in-part of our commonly assigned, co-pending United States application, Serial No. 254,097, filed January 28, 1963, now abandoned, and entitled "Improved Method and Boiler Plant for Combustion of Fuels."

The present invention broadly has reference to fuel-burning equipment and, more specifically, relates to an improved method and boiler installation for the combustion of fuels, particularly for the combustion of different fuel grades.

Boiler furnaces must be accommodated in their construction to the peculiarities of the fuel to be burned, more specifically stated, to the nature, calorific value, the combustion behaviour of such fuel, as well as to the resulting or residue products of combustion. Boiler constructions have been obtained which, strictly speaking, only ensure optimum combustion requirements for a specific fuel. When a different fuel is employed which basically differs from a fuel for which the boiler construction was designed, then it is no longer possible to expect the same economical and technical combustion results.

It oftentimes occurs in actual practice that in one and the same furnace two different fuels must be fired which basically differ from one another in their nature, calorific value and combustion properties. In such circumstances the furnace is generally so designed that both fuels can give as good a performance as is possible under the circumstances, which naturally only provides for mean or average results. The mentioned problem arises most frequently in boiler plants in which, in addition to high-grade fuel for the basic or primary firing low-grade fuels must also be burned along therewith, for example domestic refuse or garbage. Naturally, the reverse situation can also be encountered, in that for firing with low-grade refuse a high-grade fuel is called upon as supplementary or support-firing.

In the first instance, the burning of garbage or refuse results in a disproportionally increased complication of the furnace corresponding to the dimensions of the apparatus, and causes a troublesome contamination of the flue gases as well as the heat-absorbing or heating surfaces due to the entrained fly ash or flue dust. In the second case, the high-grade fuel quantity burned as a supplementary firing cannot be fully taken advantage of because of the maximum attainable combustion chamber temperatures and superheating temperatures.

Accordingly, a primary object of the present invention is to provide an improved boiler plant by means of which it is possible to burn two basically different fuels with a high degree of efficiency, whereby the aforementioned disadvantages are obviated.

The boiler plant according to the present invention is manifested in that two separated furnaces are provided, wherein the paths provided for the flue gases are completely separated within the boiler. The method of burning different fuels in a boiler installation according to the invention comprises the steps of burning different fuels in separate combustion chambers of said boiler installation, then conducting the flue gases emanating from each

fuel through a separate flow path in said boiler installation, without mixing of said flue gases in said boiler installation.

Thus another improtant object of the present invention is the provision of an improved method and apparatus of the type described providing for an efficient over-all reliability and operating economy.

Another important object of the present invention is the provision of an improved boiler plant capable of burning different fuels at increased operating economy and reliability.

Still a further important object of the present invention is to provide an improved method and steam-generating equipment for the efficient combustion of different types of fuel, while substantially providing for a minimization of slag deposits or otherwise on the heat-absorbing surfaces.

It is still another object of the invention to provide an improved method for the combustion of different fuels, whereby the path of movement of the resulting flue gases from each fuel moves completely separately throughout the boiler plant, with recombination of said separate flue gas streams occurring externally of the boiler plant.

Yet another object of the present invention is to provide improved steam-generating equipment with means for the burning of different fuels, permitting of a saving of accessory equipment, particularly dust removal equipment.

These and still further objects will become more readily apparent by referring to a preferred embodiment of the present invention given by way of illustration, and not by way of limitation, in the accompanying drawing schematically depicting a longitudinal sectional view through a boiler installation designed according to the teachings of the present invention.

Referring now to the single figure it will be recognized that the boiler installation B comprises a gastight casing or housing **20** internally provided with an impermeable partition wall **21** dividing the interior of such casing **20** into two separate combustion chambers **22** and **23** respectively, for the concurrent firing of two different fuels. More specifically, reference numeral **1** indicates the inlet for the introduction of a low-grade fuel, such as refuse or garbage, into the combustion chamber **22** for the low-grade fuel, and reference numeral **8** indicates the infeed means for the introduction of the high-grade fuel, such as oil, gas or soft coal, for instance, into the other combustion chamber **23** for the high-grade fuel. The low-grade fuel arrives at location **1'** in the form of a fuel bed or layer **1"** upon a gas permeable grate **2**, the arrow **3** schematically indicating the location of infeed of the air necessary for combustion. This low-grade fuel burns and the gaseous products of combustion thereby developed move along the flue gas path indicated by arrow **4**, leaving the boiler installation B at the location designated by reference character **5**. In the flue gas path **1'**, **4**, **5** for the gaseous products of combustion resulting from burning of the low-grade fuel there is located a first heating system of the steam generator means of the boiler B. This first heating system provides a pre-heater boiler section, generally designated by reference character P, which comprises the boiler heating surfaces **24** disposed between the headers **10** and **11** and the further heating surfaces **25** extending between the headers **12** and **13**. The heating surfaces **24** define a pre-heater or economizer and communicate with the heating surfaces **25** defining a first stage evaporator, as well as with the heating surfaces **26** and **27**, to be considered shortly, which are located in the combustion chamber **23** for the high-grade fuel. It will be appreciated that the boiler water is delivered through header **10**, in countercurrent flow to the direction of flow of the flue gases resulting from combustion of the different grade fuels

in the respective combustion compartments **22** and **23**, to flow successively through the various heating surfaces **24**, **25**, **26** and **27**.

Now the high-grade fuel introduced by means of a suitable burner **8** for instance, draws the necessary combustion air at such burner, arriving for combustion at the separate combustion chamber or compartment **23**. The products of combustion, i.e. flue gases follow the path indicated by the arrows **28** within the combustion chamber **23** and leave the boiler B at the location designated **7''**.

A further heating system, forming part of the boiler steam generator means, and which is connected with the previously considered heating system disposed in the combustion chamber **22** for the low-grade fuel, is located in the combustion chamber **23** for the high-grade fuel. This heating system provides a superheating boiler section S which incorporates the interconnected heating surfaces **26** and **27** arranged between the headers **14**, **15** and **16**, **17** respectively. As already mentioned, the boiler water flows through the heating surfaces **24**, **25**, **26** and **27** in countercurrent to the flow of the respective flue gases. It will also be understood that the heating surfaces **24**, **25**, **26** and **27** represent the partial heating surfaces of the boiler B. More precisely, while as indicated the heating surfaces **24** provide a pre-heater and heating surfaces **25** the first stage evaporator, the heating surfaces **26** define a second stage evaporator and the heating surfaces **27** the superheater.

In the heating surfaces **24** of the pre-heater or economizer the supplied water is pre-heated, in known manner, to the saturation temperature corresponding to the operating pressure of the boiler. In the first stage evaporator **25** there occurs partial evaporation of the water, which is then completed at the second stage evaporator **26**. On the other hand, in the super-heater **27** the steam is brought up to the necessary terminal temperature. It will further be understood and appreciated that for reasons of clarity in illustration, in the single figure the boiler has been illustrated for the sake of simplicity as a simple water throughflow system, a so-called single tube boiler. Naturally, in actual practice the individual heating surfaces are formed from a plurality of parallelly disposed banks of tubes of suitable form and construction, and that also at least one boiler steam drum is connected after the secondary stage evaporator **26** or also between the first stage evaporator **25** and the second stage evaporator **26**. However, for the sake of simplifying the drawing such boiler drum has been omitted and, of course, in reality all of the heating surfaces, i.e. those between headers **13** and **14** are also located within the boiler housing or casing B.

It should also be clear from the drawing and description that the heating surfaces **24**, **25** which are subjected to less load are arranged in the path of the flue gases emanating from the combustion of the low-grade fuel, namely the refuse, whereby the term "less load" is intended to signify the condition that in these tubes heat transmission takes place at lower temperatures and lower temperature drops. This is compatible with the lower temperatures and heat delivery possibilities for the flue gases emanating from the combustion of refuse. Moreover, the unavoidable soiling of the heating surfaces by the flue dust particles or otherwise entrained by the flue gases, indicated at **9**, is much less dangerous and also can be correspondingly tolerated by virtue of the lower heat load or thermal stress of the heating surfaces **24**, **25** of the pre-heater boiler section P.

On the other hand, the heating surfaces **26** of the second stage evaporator and the heating surfaces **27** of the superheater are subjected to a considerably greater thermal stress or heat load, and indeed, by the higher temperatures conditional upon the high superheating temperature of the vapor as well as by the larger temperature drop required by the prevailing temperature transmission requirements. This means that in this region, i.e. the

superheating section S, the gases must exhibit a greater temperature and a greater capacity for giving off heat, achieved in that these heating surfaces **26**, **27** which have higher demands placed upon them, are arranged in the path of flow of the flue gases emanating from the combustion of the high-grade fuel.

Due to contact of these respective flue gas streams **9** and **28** with the interconnected heating surfaces **24**, **25** and **26**, **27** respectively, of the steam generator of the inventive boiler, such flue gases give off a portion of their heat and then escape from the respective combustion chambers **22** and **23** considerably cooled, that is, at a lower temperature at locations **5** and **7''** respectively. It will also be appreciated that the design of the boiler B is undertaken such that, in spite of variable delivery of heat and different heat sources the temperatures prevailing at the locations **5** and **7''** are approximately the same. While the flue gases **9** emanating from the combustion of refuse and which are generally strongly dirty or soiled, the flue gases **28** resulting from combustion of the high-grade fuel exhibit a considerably lower soiling which, as a practical matter, can be considered to be negligible or null. As a result, soiling of the heating surfaces **26** and **27** upon which higher loads are placed is considerably prevented, this resulting in easier operation, longer longevity and higher efficiency of the boiler.

The gases **9** leaving the boiler B at the exit location **5** and resulting from the burning of the low-grade fuel are then cleaned according to a known process, that is, freed of the entrained dust particles. Such cleaning of this gas can take place, by way of example, with the schematically illustrated cyclone **6**. However, it will be appreciated that it would be also readily possible to use any other suitable de-dusting or cleaning apparatus for gases which are known to the art. The now clean gas **7'** then flows out of the gas cleaning apparatus **6** and combines with the likewise clean gas appearing at location **7''** and escaping from the combustion chamber **23** for the high-grade fuel. The commingled flue gas stream is then delivered to the surrounding or ambient atmosphere at location **18** via a suction ventilator **7**. More specifically, this can take place through the agency of a non-illustrated stack, diffusor or equivalent structure.

While there is shown and described a present preferred embodiment of the invention and there is illustrated a present preferred method of practising the same, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practised within the scope of the following claims.

What is claimed is:

1. A method of burning different grades of fuel in a boiler installation incorporating a steam generator provided with at least two operatively interconnected heating systems, one of which defines only a pre-heater boiler section and the other only a superheating boiler section, comprising the steps of concurrently burning the different grades of fuel in separate combustion chambers of said boiler installation, conducting the respective streams of flue gas emanating from each fuel thus burned through a separate flow path in said boiler installation without mixing of said flue gases in said boiler installation, the stream of flue gas emanating from burning the low-grade fuel being conducted in heat-exchange relationship past the pre-heater boiler section and the stream of flue gas emanating from burning the high-grade fuel being conducted in heat-exchange relationship past the superheating boiler section, and re-combining said respective streams of flue gas externally of said boiler installation.

2. A method of burning different grades of fuel in a boiler installation according to claim **1**; wherein said respective streams of flue gas are recombined at a location where they both possess approximately the same temperature.

3. A method of burning different fuels in a boiler installation incorporating a steam generator provided with

at least two operatively interconnected heating systems, one of which defines only a pre-heater boiler section and the other only a superheating boiler section, comprising the steps of concurrently burning different fuels in separate combustion chambers of said boiler installation, conducting the respective streams of flue gases emanating from each fuel through a separate flow path in said boiler installation without mixing of said flue gases in said boiler installation, the stream of flue gas emanating from burning the low-grade fuel being conducted in heat-exchange relationship past the pre-heater boiler section and the stream of flue gas emanating from burning the high-grade fuel being conducted in heat-exchange relationship past the superheating boiler section, and removing dust from the flue gas stream of higher dust content, then re-combining said flue gas stream from which dust has been removed with the remaining flue gas stream.

4. A method of burning different fuels in a boiler installation incorporating a steam generator provided with at least two operatively interconnected heating systems, one of which defines only a pre-heater boiler section and the other only a superheating boiler section, particularly a high-grade fuel which after combustion generates a flue gas stream of relatively low dust content and a low-grade fuel which after combustion generates a flue gas stream of relatively high dust content, comprising the steps of: concurrently burning said different fuels in separate combustion chambers of said boiler installation, then conducting the respective flue gas streams emanating from each fuel through a separate flow path through said boiler installation without commingling of said respective flue gas streams, the stream of flue gas emanating from burning the low-grade fuel being conducted in heat-exchange relationship past the pre-heater boiler section and the stream of flue gas emanating from burning the high-grade fuel being conducted in heat-exchange relationship past the superheating boiler section, thereafter cleaning said flue gas stream of relatively high dust content, and then commingling the cleaned flue gas stream with the flue gas stream of relatively low dust content externally of said boiler installation.

5. A boiler plant for the combustion of two fuels basically different as regards their nature, calorific value and combustion conditions, including two separate combustion chambers for the concurrent firing of the two different grade fuels, means defining within said boiler plant completely separate flow paths for the respective flue gases emanating from each combustion chamber in order to prevent commingling of said respective flue gases within said boiler plant, steam generator means provided with at least two operatively communicating heating systems, one of which defines only a pre-heater boiler section and the other of which defines only a superheating boiler section, said pre-heater boiler section including a pre-heater and a first stage evaporator and being disposed in heat-exchange relation in the flow path for the flue gases emanating from firing of the low-grade fuel, said superheating boiler section including a second stage evaporator and a superheater and being disposed in heat-exchange relation in the flow path for the flue gases emanating from firing of the high-grade fuel.

6. A boiler plant according to claim 5; including channel means for leading away the respective flue gases from said boiler plant, said channel means being so constructed that commingling of said respective flue gases occurs outside of said boiler plant at a location at which both said flue gases possess approximately the same temperature.

7. A common boiler installation for the combustion of at least two different fuels including a separate combustion chamber for each fuel, said fuels being concurrently fired, means defining within said boiler installation

completely separate flow paths for the respective flue gases emanating from each combustion chamber, so that commingling of said flue gases within said boiler installation is prevented, steam generator means provided with at least two operatively communicating heating systems, one of which defines only a pre-heater boiler section and the other of which defines only a superheating boiler section, said pre-heater boiler section being disposed in heat-exchange relation in the flow path for the flue gases emanating from firing of the low-grade fuel, said superheating boiler section being disposed in heat-exchange relation in the flow path for the flue gases emanating from firing of the high-grade fuel.

8. A boiler plant for the combustion of two fuels basically different as regards their nature, calorific value and combustion conditions, including two separate combustion chambers for the concurrent firing of the two different fuels, means defining within said boiler plant completely separate flow paths for the respective flue gases emanating from each combustion chamber, steam generator means provided with at least two operatively communicating heating systems, one of which defines only a pre-heater boiler section and the other of which defines only a superheating boiler section, said pre-heated boiler section being disposed in heat-exchange relation in the flow path for the flue gases emanating from firing of the low-grade fuel, said superheating boiler section being disposed in heat-exchange relation in the flow path for the flue gases emanating from firing of the high-grade fuel, gas cleaning means arranged in the flow path of one of said flue gases, said gas cleaning means being a dust removal device only associated with the flue gas emanating from combustion of the low-grade fuel.

9. A boiler plant for the combustion of two fuels basically different as regards their nature, calorific value and combustion conditions, one of said fuels being a solid low-grade fuel and the other a high-grade fuel, the combination of: two completely separate combustion chambers within the boiler plant for the concurrent firing of the two different fuels, one of said combustion chambers including a combustion grate for the burning of the solid low grade fuel, means defining within said boiler plant completely separate flow paths for the respective flue gases emanating from each combustion chamber in order to prevent commingling of said respective flue gases during their residence time in the boiler plant, steam generator means provided with at least two operatively communicating heating systems, one of which defines only a pre-heater boiler section incorporating a preheater and a first stage evaporator and the other of which only defines a superheating boiler section incorporating a second stage evaporator and a superheater, said preheater boiler section being disposed in heat-exchange relation in the flow path for the flue gases emanating from firing of the low-grade fuel, said superheating boiler section being disposed in heat-exchange relation in the flow path for the flue gases emanating from firing of the high-grade fuel.

References Cited by the Examiner

UNITED STATES PATENTS

2,557,569	6/1951	Schutt	122—240 X
2,781,746	2/1957	Armacost et al.	122—240 X
2,800,116	7/1957	Raynor et al.	122—240
2,863,424	12/1958	Koch	122—240
2,867,195	1/1959	Hanck et al.	122—240
2,891,519	6/1959	Ross	122—2
3,048,154	8/1962	Braddy	122—240

FREDERICK L. MATTESON, JR., *Primary Examiner.*

CHARLES J. MYHRE, *Examiner.*