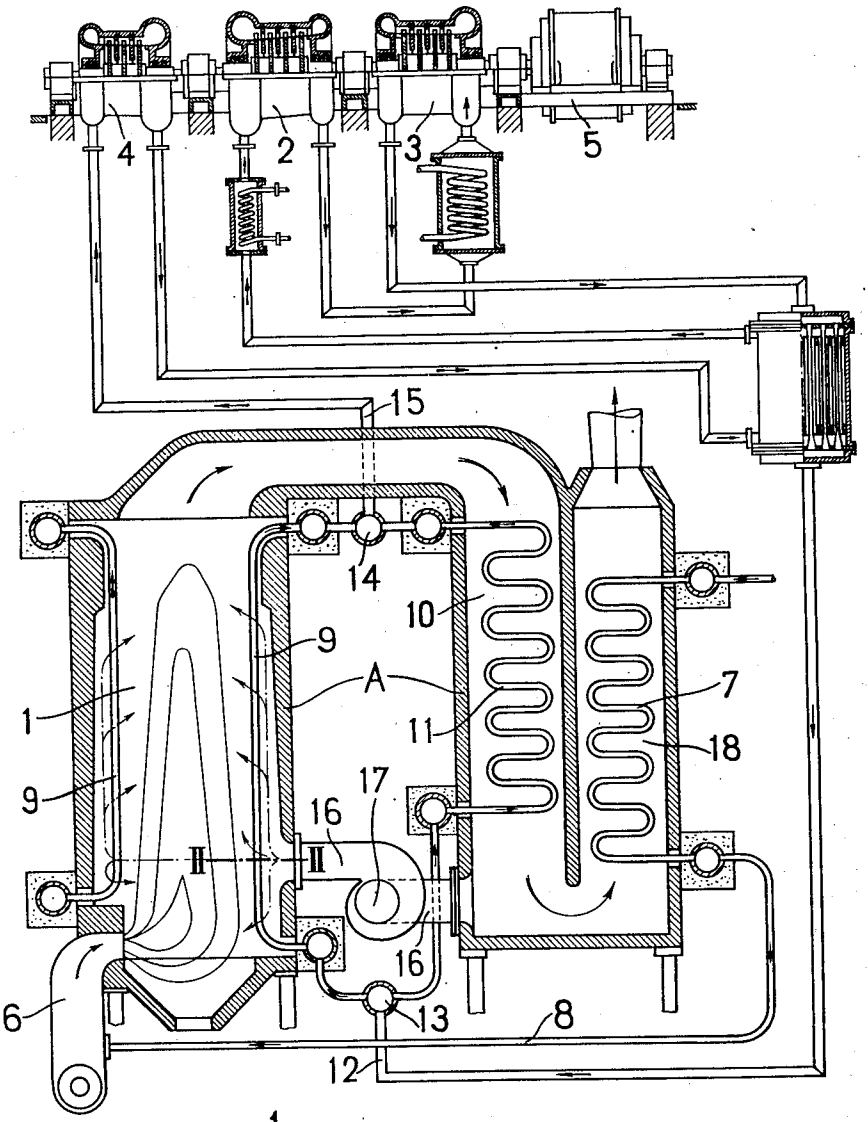
Aug. 28, 1951 H. KLEIBER 2,565,857

METHOD OF AND APPARATUS FOR PREVENTING SLAGGING IN TUBULAR ELEMENT GAS HEATING FURNACES

Filed May 15, 1946 2 Sheets-Sheet 1

Fig. 1



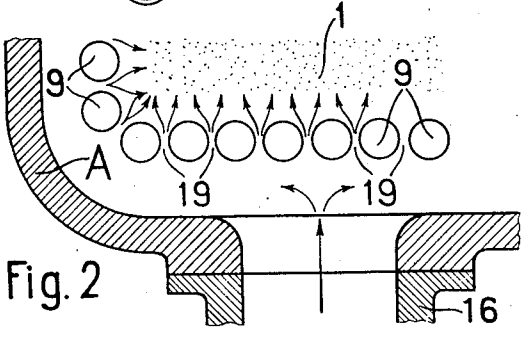


Fig. 2

Inventor
Heinz Kleiber

By Dodge Gill & Jones

Attorneys

Aug. 28, 1951 H. KLEIBER 2,565,857

METHOD OF AND APPARATUS FOR PREVENTING SLAGGING IN TUBULAR ELEMENT GAS HEATING FURNACES

Filed May 15, 1946 2 Sheets-Sheet 2

Fig. 3

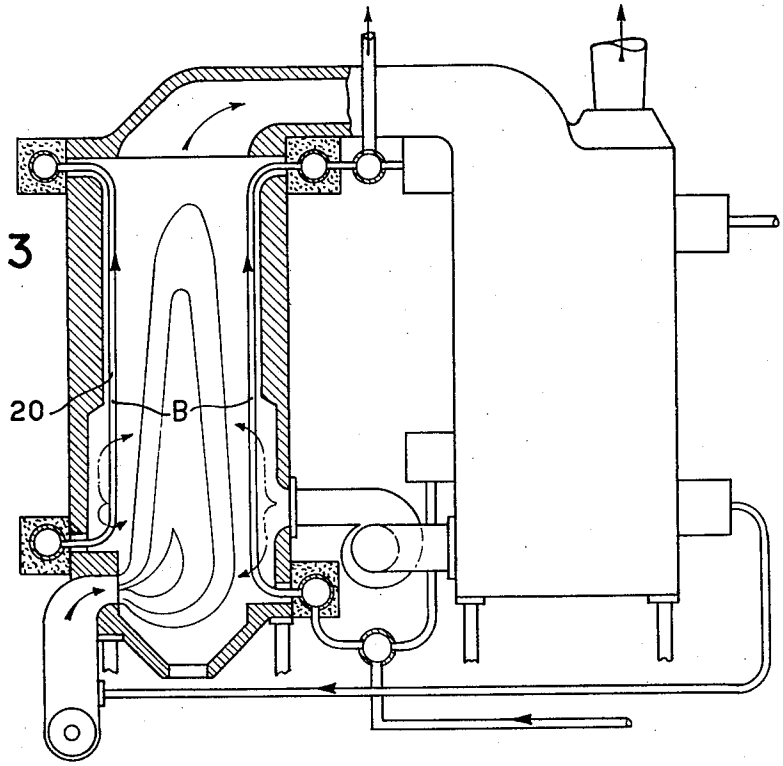


Fig. 4

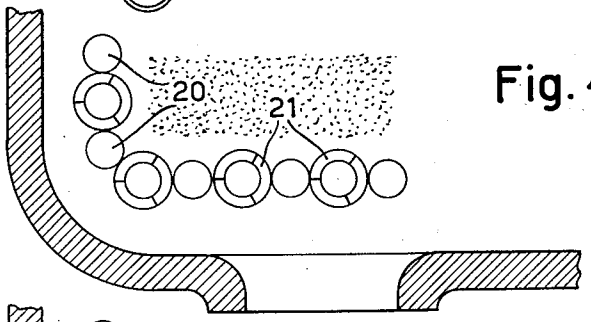
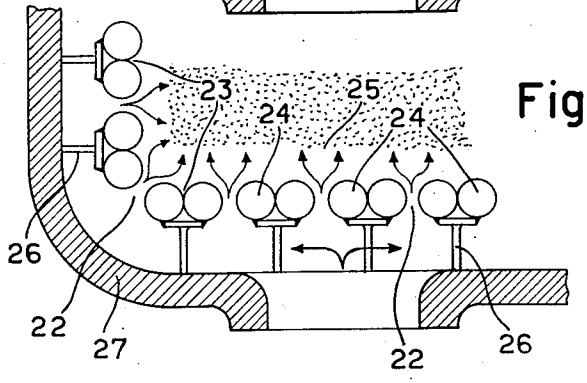


Fig. 5



Inventor
Heinz Kleiber

By Dodge Ay & Sm

Attorneys

Patented Aug. 28, 1951 2,565,857

UNITED STATES PATENT OFFICE

2,565,857

METHOD OF AND APPARATUS FOR PREVENTING SLAGGING IN TUBULAR ELEMENT GAS HEATING FURNACES

Heinz Kleiber, Zurich, Switzerland, assignor to Aktiengesellschaft Fuer Technische Studien, Zurich, Switzerland, a corporation of Switzerland

Application May 15, 1946, Serial No. 669,867
In Switzerland May 28, 1945

2 Claims. (Cl. 126—109)

1

This invention relates to a tubular gas heater which is designed in particular for thermal power plants in which a gaseous working medium, preferably air, is to be brought to a higher temperature in a heater by an indirect supply of heat from an external source.

In heaters of this kind the working medium has to be heated to temperatures between 600° and 700° C. and even more, the temperature in the furnace chamber becoming in such case correspondingly high. If therefore fuels which slag, such as pulverized coal for example have to be burnt in the heater, there is risk that liquid particles of slag will remain attached to the very hot heater tubes which is highly undesirable, as this can lead to heavy slagging in the furnace chamber in a short time. The heater tubes must also be protected from the radiant heat of the fire gases, to which end it has already been proposed to return part of the flue gases to the furnace chamber in such a way that they form a cooling layer between the fire gases and the heater tubes. In this connection the object of the present invention is to enable further improvements to be achieved by causing the returned flue gases to enter the furnace chamber through gaps between the tubes of the heater, at least at those parts which are most endangered and hottest. In this way it can be ensured that the flue gases which enter through the gaps and are already cooled down, will blow the sticky or even liquid particles of slag away from the tubes and also cool them down below their melting point, so that they solidify and liquid slag cannot in any case become deposited on the tubes. The application of the invention is therefore desirable when the fuel burnt in the furnace chamber gives rise to the production of solid or liquid constituents (that is to say sand for example when blast furnace gases are burnt). The flame also will be forced away from the tubes by the returned flue gases so that no tongues of fire can come into contact with the tubes. The layer of flue gases, which, on account of the contained carbonic acid and water affords efficient protection against radiation, can never be churned up into eddies, overheated and torn away in the furnace chamber, by the turbulence of the flue gases, as it is continually renewed from the heating surface. The new technical rule according to this invention also enables an equalisation of the tube wall temperature and heat supply to be brought about, as the cold parts of the tubes, that is to say the sides of them which are turned away from the flame are heated by the returned flue gases, while

2

those parts of the tubes which are too hot are cooled. Furthermore the combustion chamber has only to be isolated from the temperature of the returned flue gases; any possibly irradiated and heated parts of the walls of this chamber, are cooled by the returned flue gases.

Several constructional forms of the subject matter of the invention are shown by way of example in a simplified form of representation in the accompanying drawings in which:

Fig. 1 shows a heater in which air used as working medium in a power plant is to be heated, said air flowing through a part of the heater heated by radiation and through a part heated by contact in two parallel currents.

Fig. 2 is a section on the line II—II of Fig. 1, the parts of the heater which are situated below this section being omitted for the sake of simplicity, the tubes being not sectioned.

Fig. 3 shows in a view corresponding to that of Fig. 1 a second embodiment of the invention.

Fig. 4 shows in a horizontal section a part of a heater in which the tubes are fixed in their relative position by distance pieces, and

Fig. 5 shows a part of a heater in which gaps are provided between groups of tubes only, each of these groups consisting of two tubes and being affixed to the boundary wall of the furnace chamber, and the tubes being not shown in section.

In the Figures 1 and 2 numeral 1 denotes the furnace chamber, that is to say the combustion chamber, of a coal dust-fired heater A of a thermal power plant, in which air serving as working medium describes a cycle and in doing so is brought in a two-casing compressor 2, 3 to a higher pressure, then heated indirectly in the heater A by an external supply of heat and afterwards expanded in a turbine 4 which supplies energy both to the compressor 2, 3 and also to a consumer of useful output 5. Air for the support of combustion is mixed with the coal dust in a pipe 6. This air for the support of combustion is brought to the required temperature in a preheater 7, which is heated by the flue gases escaping from the heater A, and it then passes through a pipe 8 into the pipe 6. The combustion chamber 1 is lined with tubes 9 through which a part of the air of the cycle which is to be heated flows. A part of the heat contained in the fire gases is given up to these tubes 9 in the combustion chamber 1 mainly by radiation. From the combustion chamber 1 the fire gases pass into a second chamber 10, in which a heating system 11 is arranged to which the fire gases give up heat by

contact. The air to be heated in the heater A enters through a pipe 12 and divides at the distributor 13 into two parallel currents, one of which flows in the same direction as the fire gases through the tubes 9 and the other in the opposite direction to the fire gases through the heating system 11. The parallel currents thus heated combine again at the collector 14, where they enter a pipe 15 connected to the inlet of the turbine 4 and thus forming a further component of the cycle which the air, heated in the manner described, has to pursue. A part of the gases escaping from the chamber 10, that is to say a part of what is usually termed flue gases, passes into a pipe 16, in which a blower 17 is arranged, so that said part of the flue gases is returned to the furnace chamber 1. The remainder of the flue gases passes, after flowing through the pass 18, in which the above mentioned air preheater 7 is arranged, out into the open air.

The tubes 9, which line the furnace chamber 1, are so arranged that gaps 19 (Fig. 2) are left free between them. Through these gaps 19 the flue gases delivered by the blower 17 pass into the furnace chamber 1, blowing any particles of slag present off the tubes 9 in the manner shown in Fig. 2.

As shown in Fig. 3, the gaps between the heater tubes do not need to extend over the whole length of these tubes, as it may suffice for the returned flue gases to pass between the tubes 20 into the furnace chamber at those parts of the heater at least which are most endangered and hottest, i. e. only between the lower end of these tubes 20 up to the point B. In this second embodiment of the invention the tubes 20 are fixed in their relative positions by distance pieces 21 (Fig. 4), so that the necessary width of the gaps between the tubes 20 for the blowing in of returned flue gases is preserved.

As shown in Fig. 5, instead of providing a gap between every two adjacent tubes for blowing returned flue gases into the combustion chamber, gaps may be provided between groups 23 only which consist each of two pipes 24. Each group 23 is affixed to the boundary wall 27 of the furnace chamber 25 by a support 26.

The invention can be used with any arrangement and position of the tubes in the furnace chamber. The arrangement and direction of the flame in the furnace chamber likewise do not constitute essential features of the invention.

What is claimed is:

1. In a tubular gas heater, the combination of a furnace structure having walls enclosing a combustion chamber and an offtake passage leading therefrom; a tubular heat exchanger lining the combustion chamber and comprising a plurality of tubes spaced from one another and from the walls of the combustion chamber, the spacing of the tubes from the walls being greater than the spacing of the tubes from one another and the two spacings being so chosen that the interval between the lining and the chamber walls serves as a manifold space for distributing gases to be discharged through the inter-tube spaces; connections for passing gas to be heated through said tubular exchanger; a burner communicating with the combustion chamber and arranged to cause combustion therein within the space lined by said tubular heat exchanger; and means for drawing a portion of the products of combustion from said offtake passage and discharging it under pressure into said manifold space.

2. The method of resisting deposition of slag on the surfaces of a row of spaced heat exchange tubes, which comprises burning a slag evolving fuel at one side of said row of spaced tubes whereby the tubes are exposed on that side to radiant heat generated by combustion; and delivering a hot gaseous medium at a temperature lower than the temperature of combustion against the other side of said row of tubes under pressure sufficient to cause said medium to flow through the various inter-tube spaces and in a direction toward said burning fuel.

HEINZ KLEIBER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,574,546	Bell	Feb. 23, 1926
1,980,330	Gard	Nov. 13, 1934
2,139,367	Kearney	Dec. 6, 1938
2,174,663	Keller	Oct. 3, 1939
2,224,544	Keller	Dec. 10, 1940
2,380,169	Gygi	July 10, 1945