Nov. 25, 1969 J. POSPÍŠIL ET AL 3,479,882

METHOD FOR INSPECTING LINERS AND SHELLS OF HEATING DEVICES AND APPARATUS FOR PERFORMING THE METHOD

Filed Jan. 10, 1967

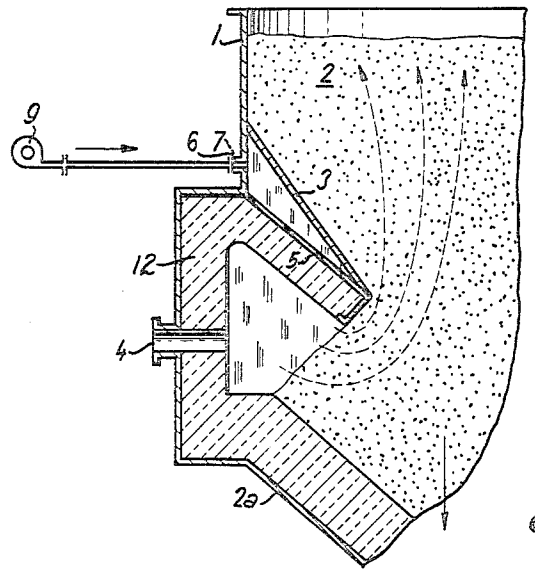


Fig. 1

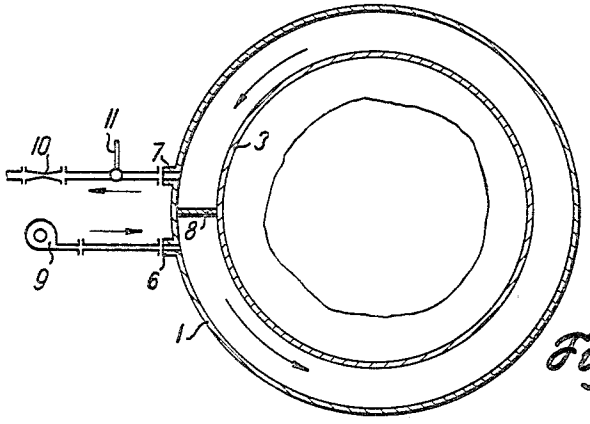


Fig. 2

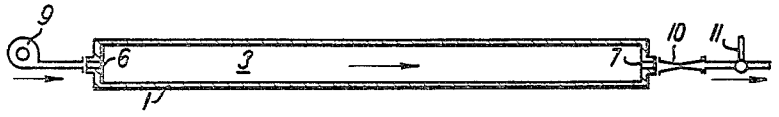


Fig. 3

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United States Patent Office 3,479,882
Patented Nov. 25, 1969

3,479,882

METHOD FOR INSPECTING LINERS AND SHELLS OF HEATING DEVICES AND APPARATUS FOR PERFORMING THE METHOD

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Filed Jan. 10, 1967, Ser. No. 608,288
Claims priority, application Czechoslovakia, Jan. 12, 1966, 170/66
Int. Cl. G01f *15/14;* G01j *5/04*
U.S. Cl. 73—432 2 Claims

ABSTRACT OF THE DISCLOSURE

A method and apparatus for sensing damage to the lines or shell of a vertical shaft heat exchanger that is used in heating granular material. An annular passage adjacent the exchanger is designed to have a uniform flow of gas from the inlet of the passage to an outlet. Temperature and flow in the outlet are measured and any deviation from normal reflects damage to the liner or shell.

The invention relates to a method for inspecting the condition of liners and shells of heating devices, for example of shaft heat exchangers in the zone of high temperatures, through which materials pass while being processed and an apparatus for performing the method.

An order to obtain the maximum efficiency of a heating device adapted for heat treatment of diffierent materials, for example granulated materials, different arrangements of interior structures have been used. Steel shells having an insulating lining have been adapted for this purpose the latter protecting the steel shell against high temperatures and increasing their lifetime.

Another object of the steel shell which forms part of the apparatus of this invention resides therein, that it is adapted to take up forces exerted by the weight of treated materials. Under normal operating conditions steel shells with lining are cooled by cold material passing along its inner wall into the zone of heat treatment. Here the mechanical and heat stresses exerted upon the lining reach a maximum volume, which sometimes cause the lining to become damaged and fall out. If the trouble is not detected and removed in due time, an excess heating of the interior structure and hence its mechanical failure may result. The entire device may thus be placed out of operation, which affects the entire production in the unit with concomitant losses of time and production and an increase in operation costs.

An optical inspection of the shell of the interior structure and of its lining is not possible and the mechanical failure is not revealed until a complete breakdown condition of the heating device occurs. Due to unforeseen tensions created by heat due and to the weight of material dangerous cracks in the shell of the interior structure may occur, which aggravates the consequences of the breakdown condition of the device.

According to the present invention, there is provided a method for inspecting the liners of the shell of the interior structures by very simple means, which considerably reduce the production and maintenance costs per unit of time and increase the efficiency of the device.

This is accomplished by introducing a stream of gas of a constant quantity and temperature into the space of the vertical shaft between the wall of the chute and the partition wall in the feed region, which thereafter travels through a peripheral passage. The quantity and temperature of this stream of gas is measured at the discharge end to indicate the condition of the lining and the shell and chute.

A partition wall is secured to the wall of the chute of the feed bin and to the adjacent vertical wall of this feed bin. In the vertical wall of the feed bin, between the upper edge of the partition wall and the upper edge of the chute of the feed bin, pipes for gas supply and discharge are provided. In the gas line between the feed and discharge passage there is a partition bar provided, and a flowmeter and a thermometer are provided in the discharge passage.

The embodiment of the invention is illustrated by way of example in the accompanying drawing which forms part of this application and in which FIG. 1 is a schematic sectional elevation of the interior structure of the heat exchanger which extends into the feed region in the zone of highest temperatures.

FIG. 2 is a horizontal cross sectional view through the feed space of the heat exchanger across the interior structure, illustrating the feed and discharge-end for gases.

FIG. 3 is a linear elevational illustration of the gas passage, comprising a double shell of the interior structure of the shaft heat exchanger.

Referring now to the drawing there is illustrated in FIGS. 1 and 2 portions of a shaft heat exchanger in accordance with this invention by a means of which the method for inspecting the liners **12** and shells of a heating device can be performed. The arrangement comprises, for example, a shaft heat exchanger, arranged preferably as a vertical shaft **1** with a feed bin **2** for introducing granular material and discharge bin **2***a* for discharge of the material after treatment. The vertical shaft **1** has a radially enlarged region in the bottom part of the feed bin **2**. The vertical wall of the feed bin **2** forms a chute **3** at the botton. In the enlarged cylindrical portion of the vertical shaft between its outside wall and the opposite interior partition wall, a channel for hot gases is provided. For this purpose there is provided a gas line **4** in the enlarged cylindrical part of the vertical shaft **1**.

The bottom end of the enlarged cylindrical part of the vertical shaft **1** defines the discharge bin **2***a*. The bottom edge of the chute **3** of the feed bin **2** extends into the bottom half of the enlarged cylindrical part of the vertical shaft **1**. The vertical shaft **1** has a circular cross section in the region of the enlarged cylindrical part. A partition wall **5** is attached to the bottom edge of chute **3** of the feed bin **2** and to the adjacent vertical wall of the feed bin **2**. In the vertical wall of the feed bin **2** opposite the wall of chute **3** there are two feed lines **6, 7**, disposed for feeding a constant quantitiy of gases into an annular passage defined by the wall of the feed bind **2**, the wall of the chute **3** and the partition wall **5**. The line **6** for gas feed and line **7** for gas discharge are separated from each other by a partition bar **8** disposed in the annular passage as illustrated in FIG. 2. A fan **9** is arranged in the feed line **6** for gases flowing into the working region between the chute **3** of the feed bin **2** and the partition wall **5** (the annular passage). A flowmeter **10** and a thermometer **11** are arranged in the discharge line **7**.

Granular material for heat treatment is introduced into the region of the vertical shaft **1** through feed bin **2**. At the same time hot gas is introduced through line **4** from a kiln (not illustrated) into the channel which is formed within the wall of the enlarged cylinder part of the vertical shaft **1** and the wall of the chute **3** of the feed bin **2**.

This gas which is introduced through the channel formed between the edge of the chute **3** of the feed bin **2** and the wall of the discharge bin **2***a* flows into the granular material countercurrently against the fed material while being cooled during this flow and discharges from the

working space of the vertical shaft **1** in a cooled condition.

At the same time a stream of gas of a constant quantity and temperature is introduced through feed line **6**; this stream of gas passes through the annular passage provided along the periphery of the vertical shaft **1**, is partially preheated and discharges through line **7** across the flowmeter **10** and thermometer **11**. If no damage occurs to the liner **12** of the partition wall **5** or to the shell, a constant quantity of gases equalling the quantity of gases introduced, discharges through line **7** across flowmeter **10** and thermometer **11**. The temperature of the discharging gases will, however, be higher, as the gas introduced through the annular peripheral passage between the chute **3** of the feed bin **2** and the partition wall **5** causes these walls to be cooled and at the same time causes the discharging gases to rise to a higher temperature degree. If a part of the liner **12** of the partition wall falls out, due to high pressures exerted by the granular material introduced through the feed bin **2** for treatment or due to too high temperatures present in the shaft heat exchanger, the temperature of the shell and consequently the temperature of the passing gases indicated at the discharge line **7** by thermometer **11** is increased.

If the pressure of the fed material or too high temperatures cause breakage of the shell, which comprises a chute **3** and a partition wall **5**, the gases passing through the annular channel defined by the chute **3** and the partition wall **5** are partially exhausted into the working space of the vertical shaft **1**.

Thus the quantity of gases discharging through line **7** and indicated by flowmeter **10** will be different in comparison with the quantity of gas introduced through line **6**.

The apparatus according to the invention makes it possible to efficiently and reliably inspect liners and shells of the interior structures of shaft heat exchangers in the zone of high temperatures. By using this apparatus breakdown of the shaft heat exchanger can be prevented, and thus a higher efficiency of the shaft heat exchanger during operation and reduced production cost can be attained.

A further advantage resides in that the maintenance cost can be cut down, because the apparatus of the invention is capable of instantaneously detecting a malfunction.

Although our invention has been illustrated and described with reference to the preferred embodiment of a shaft heat exchanger and a method for manufacturing the same, we wish to have it understood that it is in no way limited to the details of such a preferred embodiment but is capable of modifications.

What we claim is:

1. A method for inspection liners and shells of vertical shaft heat exchangers having an open top and bottom for heat treatment of granular material in a zone of high temperature disposed in said heat exchanger, said vertical shaft heat exchanger having an enlarged cylindrical portion and an annular passage arranged adjacent to said enlarge cylindrical portion, comprising the steps of

introducing said granular material into said vertical shaft heat exchanger through the top thereof;

introducing hot gases into said enlarged cylindrical portion and forcing said gases upwardly countercurrently through said granular material;

introducing a stream of gas of constant quantity and constant temperature into said annular passage;

discharging said stream of gas from said annular passage;

measuring the quantity and temperature of said stream of gas discharging from said annular passage;

and discharging said granular material through the bottom of said vertical shaft heat exchanger;

whereby measured changes in the quantity and temperature of said discharging stream of gas will immediately indicate damage to the liner and shell of said vertical shaft heat exchanger.

2. An apparatus for inspecting liners and shell of vertical shaft heat exchangers having an open top and bottom for heat treatment of granular material inserted through said top and flowing downwardly into a zone of high temperatures disposed in said heat exchanger,

wall means disposed in said heat exchanger and forming a chute therein;

said vertical shaft heat exchanger having an enlarged cylindrical portion arranged adjacent to said chute;

partition wall means extending from said wall means forming said chute to said enlarged cylindrical portion, thereby defining an annular passage in said container;

an inlet arranged in said enlarged cylindrical portion for conducting hot gases into said vertical shaft heat exchanger and countercurrently through said granular material and out of the top of said heat exchanger;

a second inlet extending into said annular passage for conducting thereto a uniform stream of gas of constant temperature;

an outlet extending from said annular passage for conducting a stream of gas out of said annular passage;

means disposed in said passage for separating the incoming and outgoing streams of gas;

fan means operatively connected to said second inlet for forcing the gas stream into said annular passage; and

flow and temperature measuring means operatively connected to said outlet for measuring the flow and temperature of the outgoing stream of gas;

whereby measured changes in the quantity and temperature of said outgoing stream of gas will immediately indicate damages to the liner and shell of said vertical shaft heat exchanger.

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U.S. Cl. X.R.

73—198, 344, 362.8; 116—114.5