United States Patent [19]

Ribesse

[11] **3,774,673**

[45] **Nov. 27, 1973**

[54] **METHOD AND DEVICE FOR HEATING GASES**

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[22] Filed: **Sept. 8, 1971**

[21] Appl. No.: **178,674**

[30] **Foreign Application Priority Data**

Sept. 9, 1970 Belgium 767,786

[52] **U.S. Cl.** **165/1**, 165/5

[51] **Int. Cl.** **F28d 17/00**

[58] **Field of Search** 165/1, 5

[56] **References Cited**

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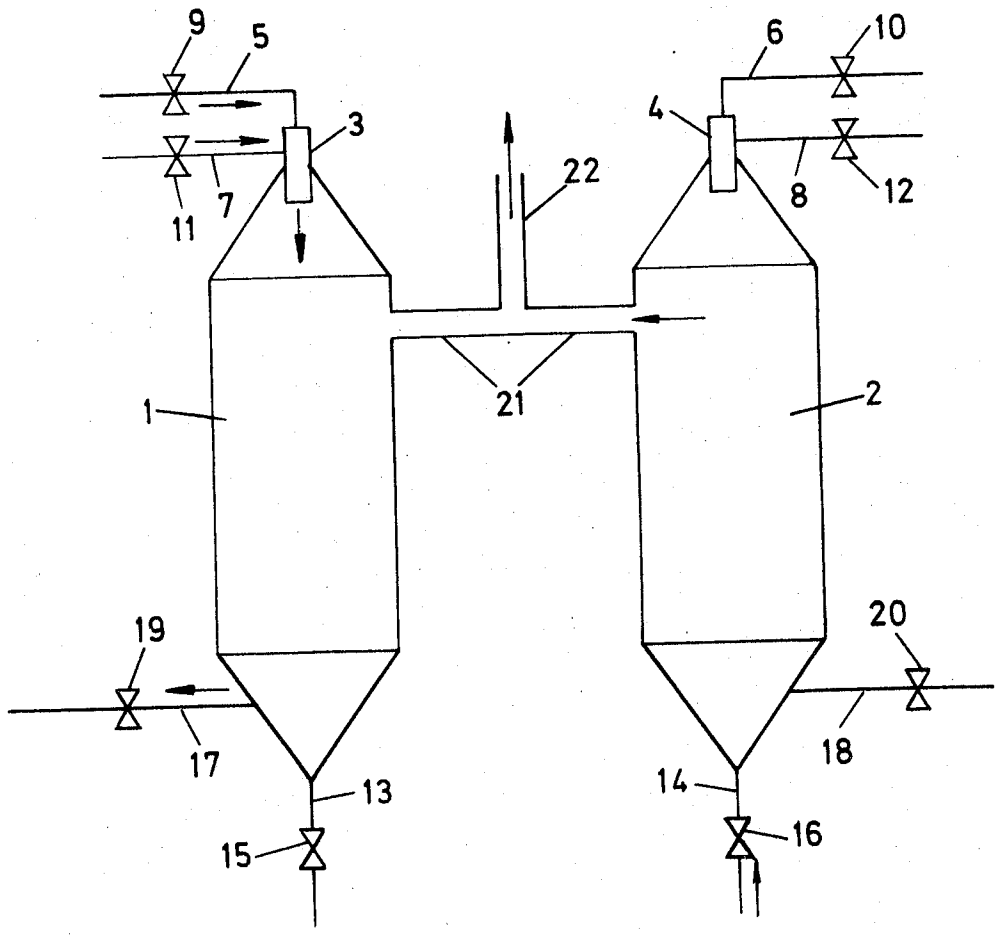
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[57] **ABSTRACT**

A method for heating of gases, particularly reformed hot gases intended for injection into a shaft furnace, in which the gases undergo a preheating treatment by passing into a heat exchanger composed of two cells, coupled in such a manner that when one is being heated the other is heating the gas and vice versa, the said two cells being interconnected at one of their ends, the said gases being introduced into the cells at the end opposite to that where the connection between the cells is effected and extracted hot at the other end.

5 Claims, 2 Drawing Figures



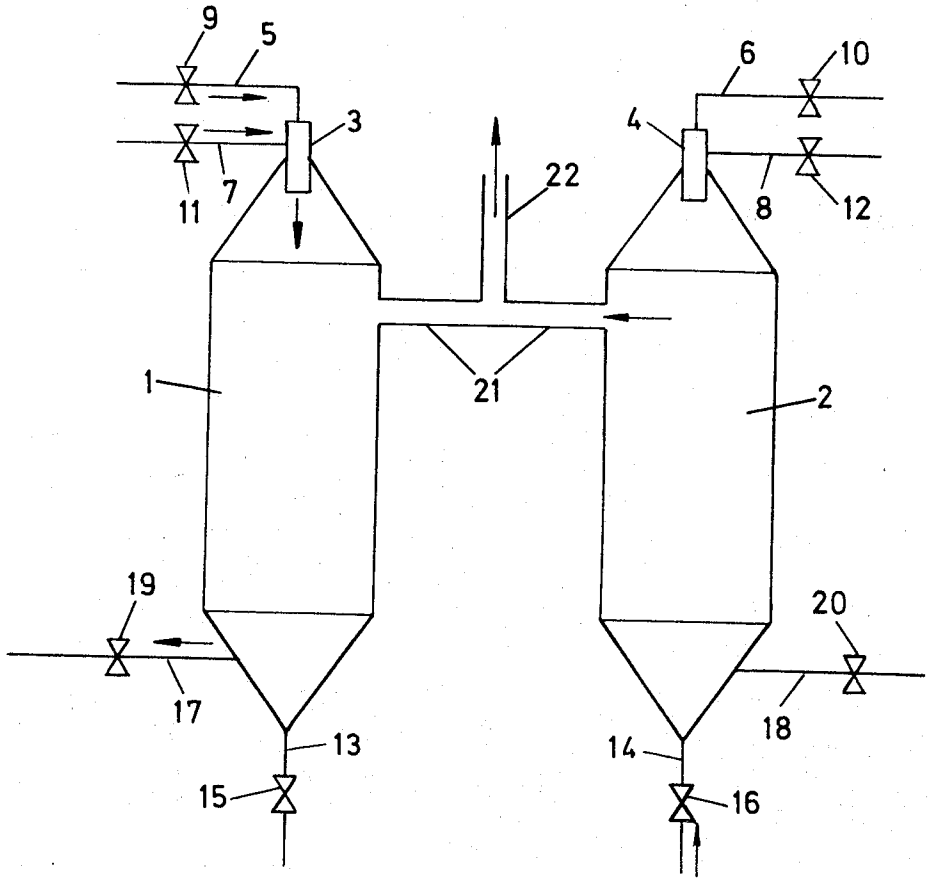


FIG. 1.

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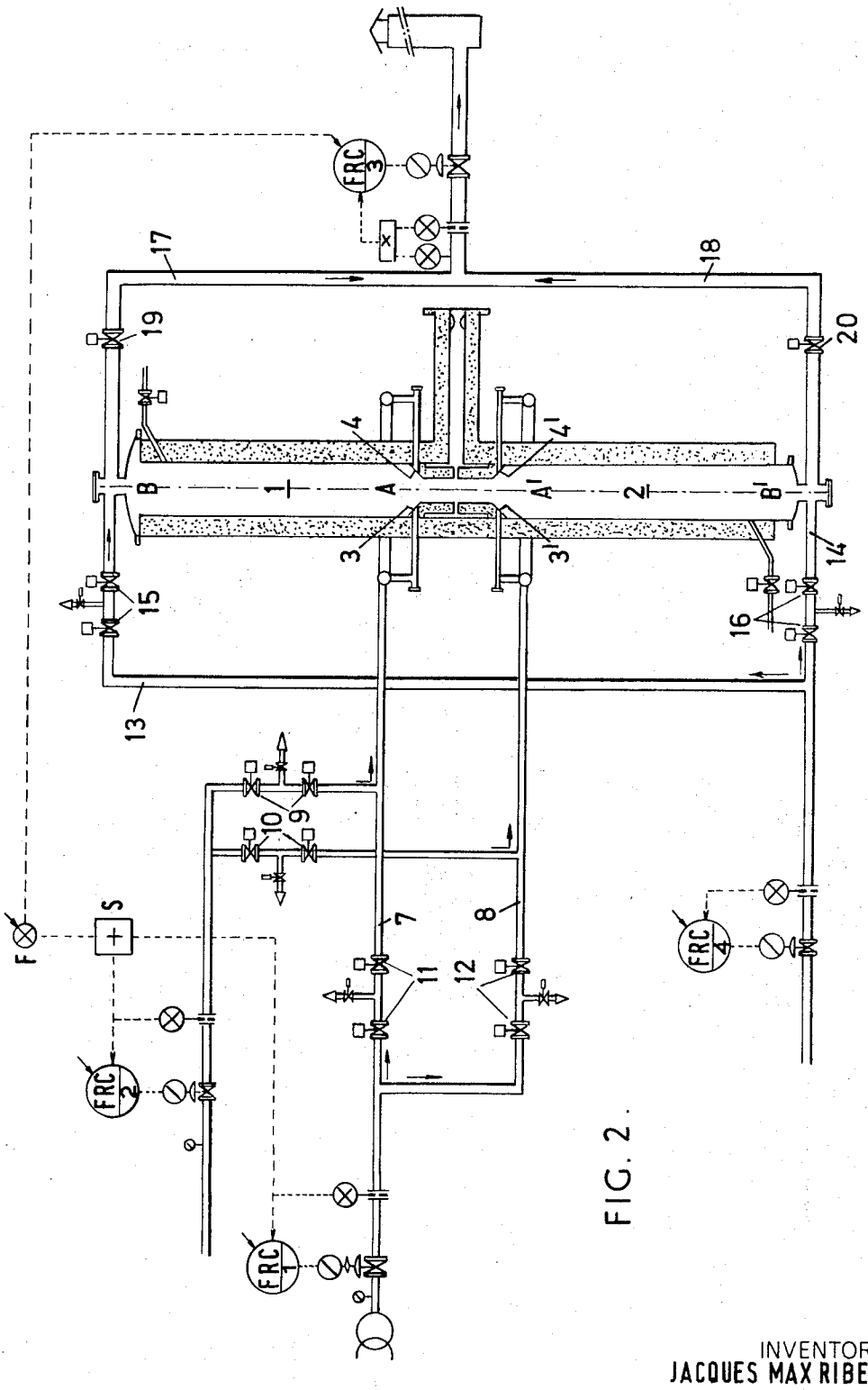


FIG. 2.

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METHOD AND DEVICE FOR HEATING GASES

The present invention relates to a method and device for heating gases and particularly reformed gases intended to be injected into shaft furnaces such as blast furnaces.

It is already known to inject reformed gases into a blast furnace with the principal aim of reducing the coke consumption, this fuel becoming more and more expensive as a result of the increasing scarcity of coking coals.

The injection of reformed gases has also been recommended to increase the possibilities of regulating the operation of the blast furnace and of the automation of such regulation. For this purpose such injections are effected in the upper part of the boshes and/or by the main tuyeres.

By the expression "reformed gas," there should be understood any gaseous mixture containing considerable proportions of hydrogen and/or carbon monoxide resulting from an oxidising and/or thermal cracking conversion treatment of a hydrocarbon fluid. This treatment is carried out in an appropriate device outside the shaft furnace.

The reformed gases must have a sufficient temperature, of the order of 1,000° C to 1,400° C, at the instant of their injection so that they do not cause a cooling in the operation of the furnace.

When the reformed gas is obtained by partial oxidation, the reaction heat is generally sufficient for the said reformed gas to be able to be injected in the shaft furnace without it being necessary for it to be pre-heated.

But in all the other cases, the necessity of such an injection temperature poses as problems not only that of the economics of the heating to heat the gases to rather elevated temperatures and/or to maintain these temperatures, but also that of safety because of the presence of hydrogen which, at these temperatures, makes up a mixture which is explosive on contact with the air.

The aim of the present invention is to resolve these problems in a very simple and a very economic manner.

The method for heating gases, particularly reformed gases intended for injection into shaft furnaces, which is the subject of the present invention is essentially characterized in that more or less cold gases undergo a pre-heating treatment by passing them into a heat exchanger composed of two cells coupled in such a manner that when one is getting hot, the other is heating the gas and vice versa, the said two cells being interconnected at one of their ends, the said gases being introduced cold into the cells at the end opposite to that where the connection between the cells are made and extracted hot at the other end.

In accordance with the invention, in the part of the heat exchanger where the connection between the two cells is made, there is arranged an output for the hot gases which output is common to the two cells, and there is maintained in the heating cell a pressure which is slightly lower than that which prevails in the gas heating cell, a fact which enables the use of a valve on the output path of the hot gases to be avoided.

From the safety point of view, the arrangement described hereinabove is very important, for the absence of valves on the output path of the hot gases eliminates any danger of hydrogen leakage which at this temperature, of the order of 1,000° C to 1,400° C, constitutes a mixture which is explosive on contact with the air.

Also, the heating period of each of these two cells is preferably achieved by at least one burner disposed in the cells in the vicinity of the extremities where the said cells are interconnected. These burners may be advantageously fed for example by natural gas and air, in such a way as to obtain combustion with a large excess of air.

With a view to safety, at the instant of changing over the working of one cell to pass from the heating of the gases to the heating up, it is advantageous to purge the cell after having closed the cold gas input valve and before starting the burner.

Further, cells equipped on the inside with a chequering of refractory bricks may be used.

The invention further consists in a method for heating of gases, particularly reformed hot gases intended for injection into a shaft furnace, in which the gases undergo a pre-heating treatment by passing into a heat exchanger composed of two cells, coupled in such a manner that when one is being heated the other is heating the gas and vice versa, the said two cells being interconnected at one of their ends, the said gases being introduced cold into the cells at the end opposite to that where the connection between the cells is effected and extracted hot at the other end.

The invention will be further described with reference to the accompanying drawings, in which:

FIG. 1 illustrates diagrammatically an arrangement of two cells to form a heat exchanger; and

FIG. 2 illustrates in detail a further embodiment of two cells forming a heat exchanger.

FIG. 1 shows by way of non-limitative example a heat exchanger made up of two cells **1** and **2** disposed next to each other, interconnected at the upper part of the exchanger by a conduit used for the output of the hot gaseous fluids coming from one or the other of the cells.

These two cells are equipped on the inside with a chequering of refractory bricks, not shown, which is similar to that of a Cowper furnace.

At the upper part of each cell is located a burner **3, 4** fed by a set of pipes for natural gas **5, 6** and for air **7, 8,** this piping being equipped with valves **9, 10, 11, 12.**

At the lower part of each of the cells **1** and **2** there is piping **13, 14** for the input of the gas to be preheated. This piping **13** and **14** is also provided with valves **15** and **16.**

This lower part of each of the cells **1** and **2** is provided with a conduit **17, 18** for the output of the combustion flue gases, and connecting the body of each cell to a chimney (not shown). Each one of the conduits **17** and **18** is equipped with a valve **19, 20.**

The cells **1** and **2** are interconnected at their upper parts by a pipe **21** to which is connected an output conduit **22** for the heated gas.

It will be seen that the arrangement is symmetrical so that each cell **1** and **2** is equally capable of acting as the heating cell and of being heated up. In this mode of operation illustrated by the arrow in FIG. **1,** gas to be heated is introduced via open valve **16** to the cell **2** and leaves by conduit **22.** Valves **10, 12** and **20** are closed. The pressure in cell **2** is higher than in cell **1** so that there is no leakage of combustion gases, or excess oxygen, into the cell **2** on conduit **22** from cell **1.** The cell **1** is heated up in the mode with valve **15** closed and valves **9, 11** and **19** open and burner **3** ignited so that

hot combustion gases are fed into cell **1** it leaves via valve **19.** On changeover, the opposite set of conditions apply.

A plant of the type which has just been described offers the advantage of safety which is better than that of Cowpers furnaces in the case particularly where gases to be heated contain hydrogen; furthermore it has the advantages of compactness and economy.

Against this however one must remove the existance of a certain dead space for example in the combustion chambers which is prejudicial when the purge of the cells has to be carried out periodically.

A particularly important variant of the apparatus for putting the above method into effect offers, compared with the plant which has just been described above, advantages of a reduced dead space, a simplified operation, and economy in the use of the purging gases.

The two-celled device which makes up this advantageous variant is such that the two cells of the heat exchanger are disposed in line in the same container; in this case, the gaseous fluids to be heated are introduced into the cells from the ends of the container and the heated gases are extracted through the ends of the cells situated in a median zone of the said common container. The device for heating the cells is disposed in the part of the cells located in the said median zone of the container.

FIG. **2** shows in an exemplary and non-limitative manner, a heat exchanger made up of two cells in accordance with this variant of the invention.

The said cells **1** and **2** are identical and of relatively small dimension in that they may have a length of the order of **3** metres and transverse section of about 1m × 1m.

These two opposed cells contain refractory materials in bulk.

At the extremity A,A′ of each cell **1, 2** disposed in the median part of the common container, are located two burners **3, 4, 3′, 4′** fed by natural gas piping **5, 6** and air piping **7, 8**; this piping is provided with double valves **9, 10, 11** and **12.**

At the part B, B′ of each of the cells which is at the extremity of the common container is disposed input piping **13, 14** for the gaseous fluids to be heated. This piping **13** and **14** is also provided with double valves **15** and **16.**

These extremities B,B′ of each one of these cells are also provided with conduits **17** and **18** for the output of the combustion flue gases connecting the body of each cell to the chimney. Each of the conduits **17** and **18** is equipped with a valve **19, 20.**

The cells are interconnected at their extremities A,A′ by a conduit **21** for which is attached the conduit **22** for the output of the heated gas.

To make the cell **1** heat up, the valves **9** and **11** for natural gas and for air are opened in order to feed the burner **3** and **4.** The combustion flue gases leave the extremity B of the cell **1** by the conduit **17** the valve **19** of which is opened and are guided towards the chimney. The valve **15** for the input of cold gas in the extremity B of the cell **1** is closed for the whole period of the accumulation of heat in the said cell **1.**

At the same time the natural gas and air valves **10** and **12** intended for the feed of the burners **3′** and **4′** of the cell **2** are closed.

The valve **16** of the piping **14** for the input of gas to be heated in part B′ of the cell **2** is opened and this gas passes through the pile of refractory materials of the said cell **2.** After having been heated up by contact with the said refractory materials the gas leaves by the conduits **21** and **22.**

It should be noted that the combustion effected by the burners **3** and **4** with which the cell **1** is equipped is regulated in such a manner that the pressure prevalent in the said cell **1** is only slightly lower than that prevalent in the cell **2.** The result of this is a small loss of hot gases but it is largely compensated by the possibility of eliminating any valve on the pipes **21** and **22** for the output of hot gases. This absence of valve is a safety measure because it eliminates any risk of hydrogen leakage to the atmosphere of such a valve, and therefore of explosion.

During the whole period of heating of the gaseous fluid in the cell **2,** the valve **20** mounted on the conduit **18** connecting the lower part of the cell **2** to the chimney is closed.

In FIG. **2** attached there is also shown the layout of the devices for regulating the different rates of flow of natural gas, air, combustion flue gases and of the gaseous fluid to be heated.

The devices used consist mainly of recorder-controllers for the rate of flow (FRC1 for the air, FRC2 for the natural gas, FRC3 for the flue gases), interconnected by a summator S which also takes into account a certain rate of leakage introduced at F.

It is this control unit which mainly enables the regulation of the difference in pressure which must be maintained between the cells.

Owing to the regulation plant which it is advantageous to use, in accordance with the invention, to ensure the correct functioning of the two-celled heat exchanger, it is possible for example to maintain the rate of flow of gas to be heated at a constant value for the whole of one cycle; one can also according to another important operative embodiment maintain constant the rate of flow of the heated gases, by appropriate modification of the rate of flow of the gases before reheating.

I claim:

1. A method of regeneratively heating a gas, comprising; introducing the gas into a regenerative heat exchanger having two cells coupled so that when one cell is being heated the other cell is heating the gas; extracting the heated gas from either cell through a common connection interconnecting the cells adjacent one end of the cell, the gas being introduced into the cell at the end opposite the said common connection; and maintaining the pressure in the cell which is being heated lower than the pressure in the cell which is heating the gas.

2. A method as claimed in claim **1,** including heating each of the two cells by means of at least one burner disposed in the cells in the vicinity of the ends where the cells are interconnected.

3. A method as claimed in claim **2,** including feeding the burner with natural gas and air.

4. A method as claimed in claim **1,** including purging each cell after completion of a period of gas heating and before commencement of a period of being heated.

5. A method as claimed in claim **1,** wherein the heat exchanger comprises a common container in which the two cells are disposed end-to-end, gas inlets at the ends of the container, gas outlets at the ends of the cells situated in the median zone of the container, a connection between the two cells in the said median zone, and a gas outlet, common to both cells, communicating with the said connection.

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