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(72) Inventeur/Inventor:
ZHU, SHUHONG, CN

(73) Propriétaire/Owner:
ZHU, SHUHONG, CN

(74) Agent: ROBIC

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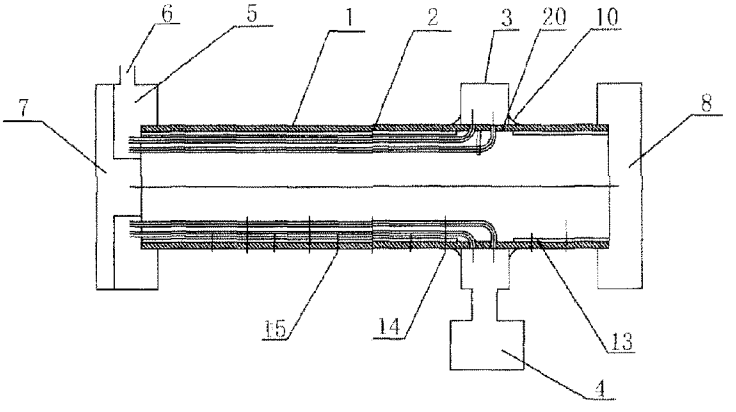

(57) Abrégé/Abstract:
A material heating device comprises a rotary kiln (1), a plurality of heat exchange tubes (2), a hot air hood (3), a high-temperature gas input mechanism (4), an exhaust collecting chamber (5), and an exhaust gas output pipeline (6), wherein, the rotary kiln (1) is provided with a feed end (7) and a discharge end (8), the heat exchange tubes (2) are provided in the rotary kiln (1), the hot air hood (3) is provided outside the rotary kiln (1), the air inlet end of the heat exchange tubes (2) is connected to the hot air hood (3), and the air outlet end of the heat exchange tubes is connected to the exhaust collecting chamber (5) that is connected to the exhaust output pipeline (6), the hot air hood (3) is in communication with the high-temperature gas input mechanism (4), and the cavity between the heat exchange tubes (2) and the insulation layer (13) of the rotary kiln (1) is a material channel. The heat exchange tubes (2) is directly in contact with the material, and most of the heat is directly transferred to the material through conduction and radiation with less heat loss. Meanwhile, the exhaust after heat exchange does not contact the coal gas generated by pyrolysis, and thus the produced coal gas has a high purity, a high heat value, and a high utility value.

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(72) 发明人; 及
(71) 申请人: 朱书红 (ZHU, Shuhong) [CN/CN]; 中国河南省南阳市西峡县双龙镇后湖村余家庄218号, Henan 474550 (CN)。

(74) 代理人: 郑州知己知识产权代理有限公司 (ZHENGZHOU ZHIJI INTELLECTUAL PROPERTY AGENCY LTD.); 中国河南省南阳市榆林北路36号绿地中心南塔710, Henan 450000 (CN)。

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(54) **Title:** MATERIAL HEATING DEVICE

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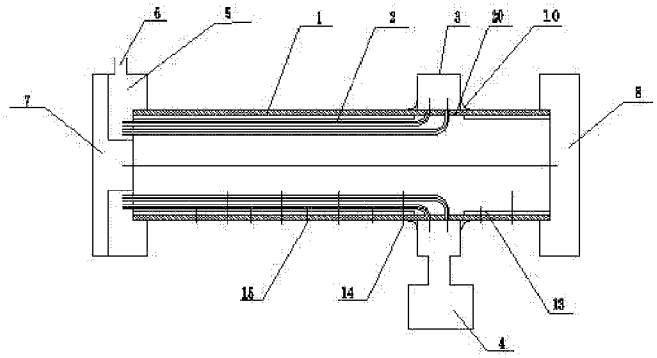

图 1

(57) **Abstract:** A material heating device comprises a rotary kiln (1), a plurality of heat exchange tubes (2), a hot air hood (3), a high-temperature gas input mechanism (4), an exhaust collecting chamber (5), and an exhaust gas output pipeline (6), wherein, the rotary kiln (1) is provided with a feed end (7) and a discharge end (8), the heat exchange tubes (2) are provided in the rotary kiln (1), the hot air hood (3) is provided outside the rotary kiln (1), the air inlet end of the heat exchange tubes (2) is connected to the hot air hood (3), and the air outlet end of the heat exchange tubes is connected to the exhaust collecting chamber (5) that is connected to the exhaust output pipeline (6), the hot air hood (3) is in communication with the high-temperature gas input mechanism (4), and the cavity between the heat exchange tubes (2) and the insulation layer (13) of the rotary kiln (1) is a material channel. The heat exchange tubes (2) is directly in contact with the material, and most of the heat is directly transferred to the material through conduction and radiation with less heat loss. Meanwhile, the exhaust after heat exchange does not contact the coal gas generated by pyrolysis, and thus the produced coal gas has a high purity, a high heat value, and a high utility value.

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本国际公布:

— 包括国际检索报告(条约第21条(3))。

— 包括经修改的权利要求(条约第19条(1))。

(57) 摘要: 一种物料加热装置，包括回转窑（1）、多个热交换管（2）、热风罩（3）、高温气体输入机构（4）、废气集气室（5）、废气输出管道（6），回转窑（1）有进料端（7）和出料端（8），热交换管（2）在回转窑（1）内，热风罩（3）在回转窑（1）窑体外，热交换管（2）的进气端与热风罩（3）连通，热交换的出气端与废气集气室（5）连通，废气集气室（5）与废气输出管道（6）连通，热风罩（3）与高温气体输入机构（4）连通，热交换管（2）与回转窑（1）隔热保温层（13）之间空腔为物料的通道，热交换管（2）与物料直接接触，热量大部分通过传导、辐射直接传给了物料，热量损失少，同时热交换后的废气又与热解产生的煤气不接触，所产煤气洁净度高，热值高，利用价值高。

MATERIAL HEATING DEVICE

Field

The present disclosure relates to the technical field of rotary kiln heating devices, and particularly to a material heating device (a device for heating a material) related to coal or biomass pyrolysis.

Background

In the technical field of coal pyrolysis, the medium-low temperature destructive distillation of coal generally employs an internal-heating shaft furnace. Internal-heating shaft furnaces are widely used because of its simple structure and low cost. However, the greatest disadvantage of the internal-heating shaft furnaces is that coal gas is mixed with the flame gas, wherein the coal gas has a low heat value, except the use of part of the coal gas for pyrolysis itself, most of the coal gas, if not being used in a lime kiln or power generation for co-production, will only be combusted and then emitted into the air, which not only causes energy waste, but also causes great environmental pollution problems. Relatively, fewer external-heating furnaces are used. The invention patent with the publication number CN101985558A and entitled "Coal Decomposing Apparatus" discloses a coal decomposing apparatus, comprising a sealed kiln body with a material feeding port and a material discharge port, wherein the kiln body is provided therein with a flame gas pipe heating mechanism, a coal propelling and decomposing channel is formed between the flame gas pipe heating mechanism and the inner wall of the kiln body, and a coal decomposed gas collecting pipe communicating with the coal propelling and decomposing channel is arranged on the kiln body. The invention patent with the publication number CN101985565A and entitled "Coal Separating Apparatus with Multiple Combustors and Parent-Son Pipes" discloses a coal separating apparatus with multiple combustors and parent-son pipes, comprising a horizontal sealed rotary kiln body, wherein the rotary kiln body is provided therein with densely arranged combustors, one ends of the densely arranged combustors are connected with corresponding densely arranged fuel gas inlet pipes and densely arranged air inlet pipes, the fuel gas inlet pipes are arranged in the inner cavities and the air inlet pipes are arranged in the outer cavities, the other ends of the densely arranged combustors are provided with densely arranged heat radiating pipes, the cavities formed among the densely arranged combustors, the densely arranged air inlet pipes, the densely arranged heat radiating pipes and the inner wall of the rotary kiln body are used as coal propelling and separating channels, the rotary kiln body is provided thereon with a coal decomposed gas collecting pipe, the densely arranged heat radiating pipes communicate with a flame gas gathering pipe, and the flame gas gathering pipe extends out of the rotary kiln. The invention patent with the publication number CN101985566A and entitled "Horizontal Rotating Apparatus for Coal Decomposition" discloses a horizontal rotating apparatus for coal decomposition, which comprises a transverse sealed rotary kiln, wherein the rotary

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kiln comprises a material feeding port and a material discharge port, a combustion device is arranged in the rotary kiln in the direction of the kiln body, a coal propelling and separating channel is formed between the combustion device and the inner wall of the rotary kiln, the coal propelling and separating channel communicates with the material feeding port and the material discharge port, the end of the rotary kiln at which the material feeding port is situated is provided with a collecting pipe of fuel gas and tar gas separated from coal, the collecting pipe of fuel gas and tar gas separated from coal communicates with the coal propelling and separating channel, and the other end of the rotary kiln is connected with a fuel gas dusting liquefaction mechanism. The three patents all effectively separate coal gas produced by coal pyrolysis from the exhaust gas produced by heating and have the characteristics of energy saving and emission reduction. However, the three patents also have a common weakness, i.e., the combustion mechanism or the heating mechanism is disposed in the kiln body. This weakness is reflected in the following aspects, i.e., the combustion condition can hardly be observed, the combustion mechanism is difficult to repair and maintain, and it is difficult to use pulverized coal as the combustion medium, otherwise, the heat dissipation pipelines will be blocked easily.

Summary

In order to solve the above problems, the technical solution of the present disclosure comprises: a material heating device, comprising a rotary kiln, a plurality of heat exchange tubes, a hot air hood, a high-temperature gas input mechanism, an exhaust gas collecting chamber and an exhaust gas output pipeline, wherein the rotary kiln is provided with a material feed end and a material discharge end, the plurality of heat exchange tubes are provided in the rotary kiln, uniformly distributed in the circumferential direction and adjacent to an inner wall of the rotary kiln, heat exchange tube brackets are provided on the inner wall of the rotary kiln, a heat insulation layer is provided on a wall of the rotary kiln, the space between the heat exchange tubes and the rotary kiln is used as a material channel, the hot air hood is provided at the periphery of a rotary kiln housing, an air inlet end of each heat exchange tube is in communication with the hot air hood, each heat exchange tube is connected with the hot air hood through an elbow, with the elbow being a part of the each heat exchange tube, an air inlet elbow end of each heat exchange tube is connected with the rotary kiln housing, the hot air hood and the rotary kiln housing form, in combination, a hot air distribution chamber, an air outlet end of each heat exchange tube is in communication with the exhaust gas collecting chamber that is in communication with the exhaust gas output pipeline, the exhaust gas collecting chamber is provided at the material feed end of the rotary kiln, the hot air hood is in communication with the high-temperature gas input mechanism, and a sealing mechanism is provided at an outer side of a portion of the hot air hood where the hot air hood is connected with the rotary kiln housing.

According to a broad aspect, there is provided a material heating device, comprising a rotary kiln, the rotary kiln comprising a material feed end, a material discharge end and an inner wall; a rotary kiln housing with a periphery; a plurality of heat exchange tubes, wherein the heat exchange tubes are in the rotary kiln, uniformly distributed in a circumferential direction and adjacent to the inner wall of the rotary kiln; a high-temperature gas input mechanism; a hot air hood at the periphery of the rotary kiln housing, the hot air hood being in communication with the high-temperature gas input mechanism; a sealing mechanism at an outer side of a portion of the hot air hood where the hot air hood is connected to the rotary kiln housing; an exhaust gas collecting chamber at the material feed end of the rotary kiln; an exhaust gas output pipeline; a heat insulation layer on the inner wall of the rotary kiln; heat exchange tube brackets on the inner wall of the rotary kiln; and a heat insulation ring on an outer side of the rotary kiln housing; wherein a space is defined between the heat exchange tubes and the rotary kiln to form a material channel; wherein an air inlet end of each heat exchange tube is in communication with the hot air hood; wherein each heat exchange tube is connected with the hot air hood through an elbow and wherein the elbow is a part of each heat exchange tube; wherein an air inlet elbow end of each heat exchange tube is connected with the rotary kiln housing; wherein an air outlet end of each heat exchange tube is in communication with the exhaust gas collecting chamber that is in communication with the exhaust gas output pipeline; wherein a heat-insulating air gap is defined between the heat insulation ring and the rotary kiln housing, the heat-insulating air gap communicating with atmosphere to cool the heat insulation ring and a corresponding portion of the rotary kiln housing; wherein the air inlet elbow end of each heat exchange tube extends through the rotary kiln housing to be connected to the heat insulation ring; and wherein the hot air hood and the heat insulation ring form, in combination, a hot air distribution chamber and a fireproof material layer on an inner side of the hot air distribution chamber.

The heat insulation layer is provided on the inner wall of the rotary kiln, wherein no heat insulation layer is provided at a local portion of the inner wall of the rotary kiln where air inlet elbow ends of the heat exchange tubes are connected with the rotary kiln housing.

Preferably, a heat insulation ring is provided on the outer side of the rotary kiln housing, a heat-insulating air gap is provided between the heat insulation ring and the rotary kiln housing, with the heat-insulating air gap communicating with the atmosphere to cool the heat insulation ring and the corresponding rotary kiln housing, the elbow ends of the heat exchange tubes penetrate through the rotary kiln housing to be connected to the heat insulation ring, the hot air hood and the insulation ring form, in combination, a hot air distribution chamber, and a fireproof material layer is provided on an inner side of the hot

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air distribution chamber formed by combination of the hot air hood and the heat insulation ring.

The heat exchange tubes are made of a heat-resistant steel, and preferably, the heat-resistant steel is 0Cr25Ni20.

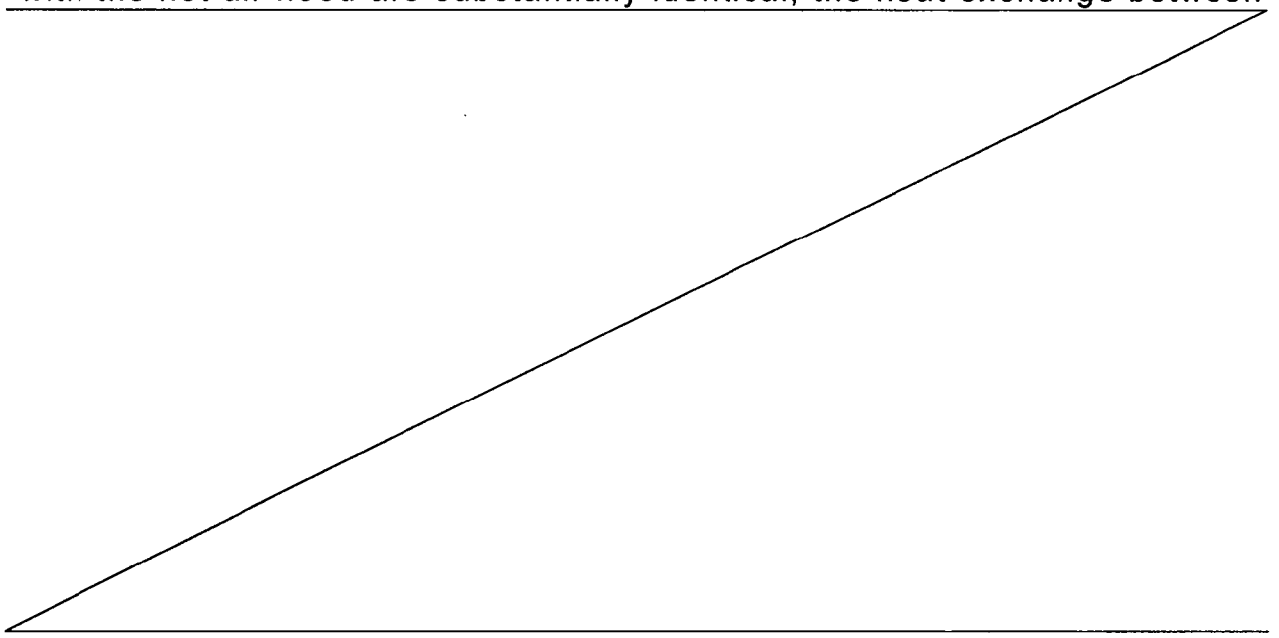
The hot air hood is located in the middle of the rotary kiln and close to the material feed end.

The heat exchange tubes are arranged in a path directly from the hot air hood to the material feed end of the rotary kiln.

One set, two sets or three sets of hot air hood and high-temperature gas input mechanism may be provided.

The rotary kiln is provided with a plurality of material temperature detection means and a plurality of heat-exchange-tube temperature detection means, wherein through feedback of the plurality of material temperature detection means and/or the plurality of heat-exchange-tube temperature detection means, combustion of the high-temperature gas input mechanism and/or the rotational speed of the rotary kiln are controlled, thereby effectively controlling the temperature within the rotary kiln.

The advantageous effects of the present disclosure are as follows: (1) The hot air hood is provided at the periphery of the rotary kiln housing and serves the function of distributing the heating gas, in the rotating process of the rotary kiln, the amounts of heat distributed to the heat exchange tubes connected with the hot air hood are substantially identical, the heat exchange between



the heat exchange tubes and the material are accordingly uniform, the degrees of coal pyrolysis at the corresponding sections along the axis of the rotary kiln are consistent, the interior and the exterior of the heat exchange tube are two separate systems, therefore, the coal gas produced by pyrolysis does not contain the exhaust gas generated by heating, then the coal gas has a relatively high heat value and a high utility value, and will not be burnt off in vain, which can achieve energy saving and emission reduction. Also, the defects in the patent with the publication number CN101985565A and entitled "Coal Separating Apparatus with Multiple Combustors and Parent-Son Pipes", etc. are avoided, i.e., since the heat dissipation mechanisms and the heating mechanisms are both arranged in the rotary kiln, some heating mechanisms can heat normally, but some cannot heat normally, this further causes the heat dissipation mechanisms, which are supposed to preheat the materials, to absorb heat from the materials due to that some heating mechanisms cannot heat normally, as a result, the effective utilization rate of the apparatus is significantly decreased, the heat dissipation pipes do not expand and contract equally, the thermal stress inside the apparatus is large, and the service life of the apparatus is reduced. The heat-insulating insulation layer is provided on the inner wall of the rotary kiln, which enables the rotary kiln to have high utilization rate of thermal efficiency and the rotary kiln housing to have a low temperature, making the rotary kiln safe and reliable. (2) The hot air hood does not generate heat directly, instead, heat is transferred thereto from the high-temperature gas input mechanism which generates heat through combustion, the high-temperature gas input mechanism is located outside the kiln, making the combustion condition thereof easily observed, and it is relatively easy to overhaul and maintain the combustor, which avoids the problem in the patent with the publication number CN101985565A and entitled "Coal Separating Apparatus with Multiple Combustors and Parent-Son Pipes", etc., that the combustion condition cannot be easily observed and the apparatus is difficult to overhaul and maintain. Moreover, gaseous, liquid and solid combustible mediums, such as pulverized coal, can all be used in the high-temperature gas input mechanism. (3) The functions of the elbow connecting the heat exchange tube with the hot air hood: 1. the heat exchange tube and the hot air hood cannot be connected directly, but can be successfully connected through the elbow; and 2. through the elbow, the high-temperature gas can smoothly make a 90-degree turning, and the 90-degree elbow is easy to realize processing and field construction with a 90-degree phase difference. (4) The purpose of providing a heat insulation layer is to minimize transferring of heat to the kiln housing from the rotary kiln, so as to reduce heat loss, and the purpose of not providing a heat insulation layer at a local portion of the inner wall of the rotary kiln where air inlet elbow ends of the heat exchange tubes are connected with the rotary kiln housing is to make the heat transferred from the hot air distribution chamber to the rotary kiln housing subjected to heat exchange between the materials and the

housing as soon as possible to cool down the portion of the rotary kiln housing where the hot air distribution chamber is located, so as to increase the strength of the rotary kiln housing at this position. (5) The functions of providing a heat insulation ring on the rotary kiln housing are as follows: by providing the heat insulation ring, the heat of the hot air hood cannot be directly transferred to the kiln housing, and the portion of the kiln housing where the insulation ring is located is cooled by air or water brought by the gap formed between the heat insulation ring and the kiln housing, which reduces the temperature of the portion of the kiln housing and reduces the strength reduction effect of high temperature on the kiln housing. (6) The use of 0Cr25Ni20 heat-resistant steel for the heat exchange tube serves to impart a longer service life to the heat exchange system. (7) The purpose of providing a fireproof material on the inner side of the hot air distribution chamber formed by the hot air hood and the rotary kiln housing or by the hot air hood and the heat insulation ring is to reduce heat loss and simultaneously protect the hot air hood, the rotary kiln housing and the heat insulation ring. (8) The arrangement that the heat exchange tubes are arranged in a path which goes firstly towards the material discharge end and then turns 180 degrees to go towards the material feed end is of important significance on the following two aspects: 1. facilitating temperature distribution characteristic, of coal pyrolyzing at the rotary position, with relatively uniform temperatures, rapid coal pyrolysis and highest oil yield; and 2. adjusting the position where the hot air hood is located to avoid the position of a roller. (9) Providing two or three hot air hoods can realize heating the rotary kiln by sections and controlling the temperature of the rotary kiln by sections. (10) The rotary kiln is provided with a plurality of material temperature detection means and a plurality of heat-exchange-tube temperature detection means, and through feedback of the plurality of material temperature detection and/or the plurality of heat-exchange-tube temperature detection, combustion of the high-temperature gas input mechanism and/or the rotational speed of the rotary kiln can be controlled, thereby effectively controlling the temperature within the rotary kiln such that it conforms to the temperature required by the process.

Brief Description of Drawings

FIG. 1 is a schematic diagram according to an embodiment, in which the hot air hood and the rotary kiln housing form, in combination, a hot air distribution chamber and the heat exchange tubes are arranged in a path directly from the hot air hood to the material feed end of the rotary kiln;

FIG. 2 is a schematic diagram according to an embodiment, in which the hot air hood and the rotary kiln housing form, in combination, a hot air distribution chamber, some of the heat exchange tubes are arranged in a direction directly from the hot air hood to the material feed end of the rotary kiln, and the other heat exchange tubes are arranged in a path which goes firstly towards the

material discharge end and then turns 180 degrees to go towards the material feed end;

FIG. 3 is a schematic diagram according to an embodiment, in which the hot air hood and the heat insulation ring form, in combination, a hot air distribution chamber, the heat exchange tubes are arranged in a path directly from the hot air hood to the material feed end of the rotary kiln, and two hot air hoods preheat the rotary kiln by sections; and

FIG. 4 is a schematic diagram according to an embodiment, in which the hot air hood and the heat insulation ring form, in combination, a hot air distribution chamber, some of the heat exchange tubes are arranged in a path directly from the hot air hood to the material feed end of the rotary kiln, and the other heat exchange tubes are arranged in a path which goes firstly towards the material discharge end and then turns 180 degrees to go towards the material feed end.

Detailed Description of Embodiments

Embodiment I:

FIG. 1 shows a material heating device, comprising a rotary kiln 1, a plurality of heat exchange tubes 2, a hot air hood 3, a high-temperature gas input mechanism 4, an exhaust gas collecting chamber 5 and an exhaust gas output pipeline 6, wherein the rotary kiln is provided with a material feed end 7 and a material discharge end 8, the plurality of heat exchange tubes 2 are provided in the rotary kiln 1 and uniformly distributed in the circumferential direction, material channels are formed between the heat exchange tubes 2 and the inner cavity of the rotary kiln 1, the hot air hood 3 is provided at the periphery of a rotary kiln 1 housing (housing of the rotary kiln 1), an air inlet end of each heat exchange tube 2 is in communication with the hot air hood 3, each heat exchange tube 2 is connected with the hot air hood 3 through an elbow, with the elbow being a part of the heat exchange tube 2, the hot air hood 3 and the rotary kiln 1 housing form, in combination, a hot air distribution chamber, an air inlet elbow end of each heat exchange tube 2 is connected with the rotary kiln 1 housing, an air outlet end of each heat exchange tube 2 is in communication with the exhaust gas collecting chamber 5, the exhaust gas collecting chamber 5 is in communication with the exhaust gas output pipeline 6, the exhaust gas collecting chamber 5 is provided at the material feed end 7 of the rotary kiln 1, the hot air hood 3 is in communication with the high-temperature gas input mechanism 4, a sealing mechanism 10 is provided at an outer side of a portion of the hot air hood 3 where the hot air hood is connected with the rotary kiln 1 housing, and a heat insulation layer 13 is provided on the inner surface of the rotary kiln 1 housing, wherein no heat insulation layer is provided at a local portion of the inner surface of the rotary kiln 1 housing where the air inlet elbow ends of the heat exchange tubes 2 are connected with the rotary kiln 1 housing.

The heat exchange tubes 2 are made of a heat-resistant steel, and preferably, the heat-resistant steel is 0Cr25Ni20.

A fireproof material is provided on an inner side of a hot air distribution chamber formed by combination of the hot air hood 3 and the rotary kiln 1 housing.

The hot air hood 3 is located in the middle of the rotary kiln 1 and close to the material discharge end 8.

The heat exchange tubes 2 are arranged in a path directly from the hot air hood 3 to the material feed end 7 of the rotary kiln 1, and the hot air hood 3 is one in number.

The rotary kiln 1 is provided with a plurality of material temperature detection means 14, wherein through feedback of the plurality of material temperature detection means 14, combustion in the high-temperature gas input mechanism 4 can be controlled, thereby effectively controlling the temperature within the rotary kiln, such that it conforms to the temperature required by the process.

Embodiment II:

FIG. 2 shows a material heating device, comprising a rotary kiln 1, a plurality of heat exchange tubes 2, a hot air hood 3, a high-temperature gas input mechanism 4, an exhaust gas collecting chamber 5 and an exhaust gas output pipeline 6, wherein the rotary kiln 1 is provided with a material feed end 7 and a material discharge end 8, the plurality of heat exchange tubes 2 are provided in the rotary kiln 1 and uniformly distributed in the circumferential direction, channels of materials under processing are between the heat exchange tubes 2 and the inner cavity of the rotary kiln 1, the hot air hood 3 is provided at the periphery of a rotary kiln 1 housing, an air inlet end of each heat exchange tube 2 is in communication with the hot air hood 3, each heat exchange tube 2 is connected with the hot air hood 3 through an elbow, with the elbow being a part of the heat exchange tube 2, the hot air hood 3 and the rotary kiln 1 housing form, in combination, a hot air distribution chamber, an air inlet elbow end of each heat exchange tube 2 is connected with the rotary kiln 1 housing, an air outlet end of each heat exchange tube 2 is in communication with the exhaust gas collecting chamber 5, the exhaust gas collecting chamber 5 is in communication with the exhaust gas output pipeline 6, the exhaust gas collecting chamber 5 is provided at the material feed end 7 of the rotary kiln 1, the hot air hood 3 is in communication with the high-temperature gas input mechanism 4, a sealing mechanism 10 is provided at an outer side of a portion of the hot air hood 3 where the hot air hood is connected with the rotary kiln 1 housing, a heat insulation layer 13 is provided on the inner surface of the rotary kiln 1 housing, a heat insulation layer 13 is provided on the inner surface of the rotary kiln 1 housing, wherein no heat insulation layer is provided at a local portion of the inner surface of the rotary kiln 1 housing where the air inlet elbow ends of the heat exchange tubes 2 are connected with the rotary kiln 1 housing.

The heat exchange tubes 2 are made of a heat-resistant steel, and preferably, the heat-resistant steel is 0Cr25Ni20.

A fireproof material is provided on an inner side of a hot air distribution chamber formed by combination of the hot air hood 3 and the rotary kiln 1 housing.

Some of the heat exchange tubes 2 are arranged in a path directly from the hot air hood 3 to the material feed end 7 of the rotary kiln 1, and the other heat exchange tubes 2 are arranged in a direction firstly towards the material discharge end 8 and then turns 180 degrees to go towards the material feed end 7.

The hot air hood 3 is one in number.

The rotary kiln 1 is provided with a plurality of material temperature detection means 14 and a plurality of heat-exchange-tube temperature detection means 15, wherein through feedback of the plurality of material temperature detection means 14 and the plurality of heat-exchange-tube temperature detection means 15, combustion in the high-temperature gas input mechanism and the rotational speed of the rotary kiln can be controlled, thereby effectively controlling the temperature within the rotary kiln, such that it conforms to the temperature required by the process.

Embodiment III:

FIG. 3 shows a material heating device, comprising a rotary kiln 1, a plurality of heat exchange tubes 2, a hot air hood 3, a high-temperature gas input mechanism 4, an exhaust gas collecting chamber 5 and an exhaust gas output pipeline 6, wherein the rotary kiln is provided with a material feed end 7 and a material discharge end 8, the plurality of heat exchange tubes 2 are provided in the rotary kiln 1 and uniformly distributed in the circumferential direction, material heating channels are formed between the heat exchange tubes 2 and the inner cavity of the rotary kiln 1, the hot air hood 3 is provided at the periphery of a rotary kiln 1 housing, an air inlet end of each heat exchange tube 2 is in communication with the hot air hood 3, each heat exchange tube 2 is connected with the hot air hood 3 through an elbow, with the elbow being a part of the heat exchange tube 2, an air outlet end of each heat exchange tube 2 is in communication with the exhaust gas collecting chamber 5, the exhaust gas collecting chamber 5 is in communication with the exhaust gas output pipeline 6, the exhaust gas collecting chamber 5 is provided at the material feed end 7 of the rotary kiln 1, the hot air hood 3 is in communication with the high-temperature gas input mechanism 4, and a sealing mechanism 10 is provided at an outer side of a portion of the hot air hood 3 where the hot air hood is connected with the rotary kiln 1 housing, and a heat insulation layer 13 is provided on the inner surface of the rotary kiln 1 housing.

A heat insulation ring 11 is provided on the outer side of the rotary kiln 1 housing, a heat-insulating air gap 12 is provided between the heat insulation ring 11 and the rotary kiln 1 housing, with the heat-insulating air gap 12 communicating with the atmosphere to

cool the heat insulation ring 11 and the corresponding rotary kiln 1 housing, the elbow ends of the heat exchange tubes 2 penetrate through the rotary kiln 1 housing to be connected to the heat insulation ring 11, and the hot air hood 3 and the insulation ring 11 form, in combination, a hot air distribution chamber.

The heat exchange tubes 2 are made of a heat-resistant steel, and preferably, the heat-resistant steel is 0Cr25Ni20.

A fireproof material is provided on an inner side of a hot air distribution chamber formed by combination of the hot air hood 3 and the heat insulation ring 11.

The heat exchange tube 2 is arranged in a path directly from the hot air hood 3 to the material feed end 7 of the rotary kiln 1.

The hot air hoods 3 are two in number, and supply heat to the rotary kiln by sections.

The rotary kiln 1 is provided with a plurality of material temperature detection means 14 and a plurality of heat-exchange-tube temperature detection means 15, wherein through feedback of the plurality of material temperature detection means 14 or the plurality of heat-exchange-tube temperature detection means 15, combustion in the high-temperature gas input mechanism or the rotational speed of the rotary kiln can be controlled, thereby effectively controlling the temperature within the rotary kiln, such that it conforms to the temperature required by the process.

Embodiment IV:

FIG. 4 shows a material heating device, comprising a rotary kiln 1, a plurality of heat exchange tubes 2, a hot air hood 3, a high-temperature gas input mechanism 4, an exhaust gas collecting chamber 5 and an exhaust gas output pipeline 6, wherein the rotary kiln is provided with a material feed end 7 and a material discharge end 8, the plurality of heat exchange tubes 2 are provided in the rotary kiln 1 and uniformly distributed in the circumferential direction, material channels are formed between the heat exchange tubes 2 and the inner cavity of the rotary kiln 1, the hot air hood 3 is provided at the periphery of a rotary kiln 1 housing, an air inlet end of each heat exchange tube 2 is in communication with the hot air hood 3, each heat exchange tube 2 is connected with the hot air hood 3 through an elbow, with the elbow being a part of the heat exchange tube 2, an air outlet end of each heat exchange tube

2 is in communication with the exhaust gas collecting chamber 5, the exhaust gas collecting chamber 5 is in communication with the exhaust gas output pipeline 6, the exhaust gas collecting chamber 5 is provided at the material feed end 7 of the rotary kiln 1, the hot air hood 3 is in communication with the high-temperature gas input mechanism 4, and a sealing mechanism 10 is provided at an outer side of a portion of the hot air hood 3 where the hot air hood is connected with the rotary kiln 1 housing, and a heat insulation layer 13 is provided on the inner surface of the rotary kiln 1 housing.

A heat insulation ring 11 is provided on the outer side of the rotary kiln 1 housing, a heat-insulating air gap 12 is provided between the heat insulation ring 11 and the rotary kiln 1 housing, with the heat-insulating air gap 12 communicating with the atmosphere to cool the heat insulation ring 11 and the corresponding rotary kiln 1 housing, the elbow ends of the heat exchange tubes 2 penetrate through the rotary kiln 1 housing to be connected to the heat insulation ring 11, and the hot air hood 3 and the heat insulation ring 11 form, in combination, a hot air distribution chamber.

The heat exchange tubes 2 are made of a heat-resistant steel, and preferably, the heat-resistant steel is 0Cr25Ni20.

A fireproof material is provided on an inner side of a hot air distribution chamber formed by combination of the hot air hood 3 and the heat insulation ring 11.

Some of the heat exchange tubes 2 are arranged in a path directly from the hot air hood 3 to the material feed end 7 of the rotary kiln 1, and the other heat exchange tubes 2 are arranged in a path which goes firstly towards the discharge end 8 and then turns 180 degrees to go towards the material feed end 7.

The rotary kiln is provided with a plurality of material temperature detection means 14 and a plurality of heat-exchange-tube temperature detection means 15, wherein through feedback of the plurality of material temperature detection means 14 and the plurality of heat-exchange-tube temperature detection means 15, combustion in the high-temperature gas input mechanism and the rotational speed of the rotary kiln can be controlled, thereby effectively controlling the temperature within the rotary kiln, such that it conforms to the temperature required by the process.

The above description merely illustrates some embodiments of the present disclosure, which are not intended to limit the present disclosure. For a person skilled in the art, various variations, substitutions and modifications may be made to the heating device of the present disclosure according to needs. Any modifications, equivalent substitutions, improvements and so on made within the spirit and principle of the present disclosure shall fall within the scope of the claims of the present disclosure.

CLAIMS

1. A material heating device, comprising

a rotary kiln, the rotary kiln comprising a material feed end, a material discharge end and an inner wall;

a rotary kiln housing with a periphery;

a plurality of heat exchange tubes, wherein the heat exchange tubes are in the rotary kiln, uniformly distributed in a circumferential direction and adjacent to the inner wall of the rotary kiln;

a high-temperature gas input mechanism;

a hot air hood at the periphery of the rotary kiln housing, the hot air hood being in communication with the high-temperature gas input mechanism;

a sealing mechanism at an outer side of a portion of the hot air hood where the hot air hood is connected to the rotary kiln housing;

an exhaust gas collecting chamber at the material feed end of the rotary kiln;

an exhaust gas output pipeline;

a heat insulation layer on the inner wall of the rotary kiln;

heat exchange tube brackets on the inner wall of the rotary kiln; and

a heat insulation ring on an outer side of the rotary kiln housing;

wherein a space is defined between the heat exchange tubes and the rotary kiln to form a material channel;

wherein an air inlet end of each heat exchange tube is in communication with the hot air hood;

wherein each heat exchange tube is connected with the hot air hood through an elbow and wherein the elbow is a part of each heat exchange tube;

wherein an air inlet elbow end of each heat exchange tube is connected with the rotary kiln housing;

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wherein an air outlet end of each heat exchange tube is in communication with the exhaust gas collecting chamber that is in communication with the exhaust gas output pipeline;

wherein a heat-insulating air gap is defined between the heat insulation ring and the rotary kiln housing, the heat-insulating air gap communicating with atmosphere to cool the heat insulation ring and a corresponding portion of the rotary kiln housing;

wherein the air inlet elbow end of each heat exchange tube extends through the rotary kiln housing to be connected to the heat insulation ring; and

wherein the hot air hood and the heat insulation ring form, in combination, a hot air distribution chamber and a fireproof material layer on an inner side of the hot air distribution chamber.

2. The material heating device according to claim 1, wherein the heat insulation layer is on the inner wall of the rotary kiln and wherein a local portion of the inner wall of the rotary kiln where the air inlet elbow ends of the heat exchange tubes are connected with the rotary kiln housing is devoid of heat insulation layer.

3. The material heating device according to any one of claims 1 to 2, wherein the heat exchange tubes are made of a heat-resistant steel.

4. The material heating device according to claim 3, wherein the heat-resistant steel is 0Cr25Ni20.

5. The material heating device according to any one of claims 1 to 4, wherein the hot air hood is located in a middle of the rotary kiln and is close to the material discharge end.

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6. The material heating device according to any one of claims 1 to 5, wherein the heat exchange tubes are arranged in a path directly from the hot air hood to the material feed end of the rotary kiln.

7. The material heating device according to any one of claims 1 to 5, wherein the heat exchange tubes are arranged in a path firstly being directed towards the material discharge end and then turning 180° to go towards the material feed end.

8. The material heating device according to any one of claims 1 to 7, comprising one set, two sets or three sets of hot air hood and high-temperature gas input mechanism.

9. The material heating device according to any one of claims 1 to 8, wherein the rotary kiln comprises a plurality of material temperature detection means and a plurality of heat-exchange-tube temperature detection means, wherein through feedback of the plurality of material temperature detection means and/or the plurality of heat-exchange-tube temperature detection means, combustion of the high-temperature gas input mechanism and/or a rotational speed of the rotary kiln are controlled for controlling a temperature within the rotary kiln.

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Drawings:

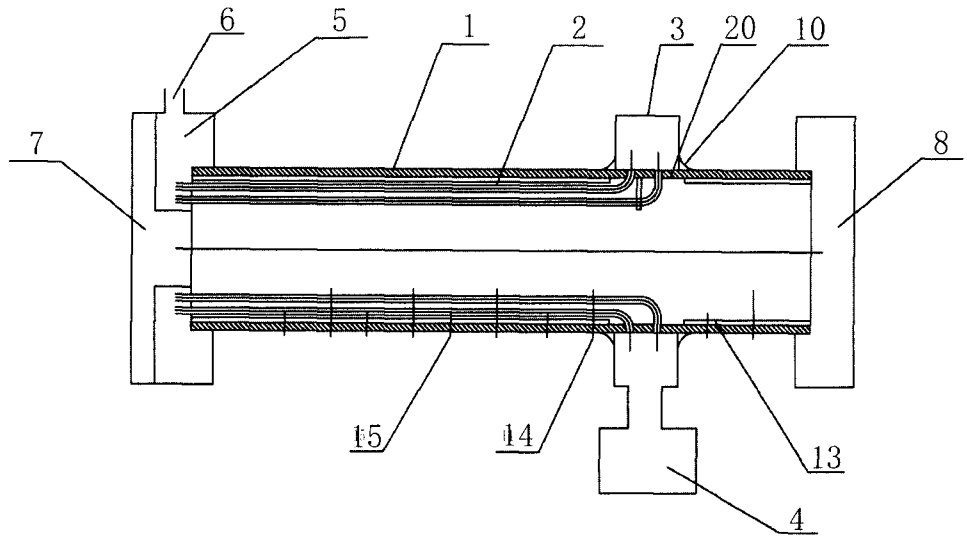


FIG. 1

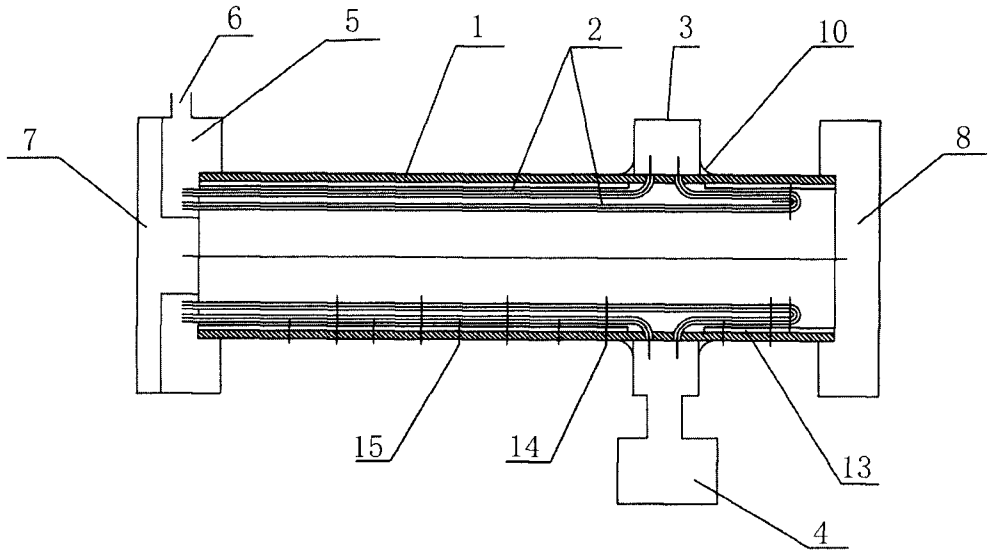


FIG. 2

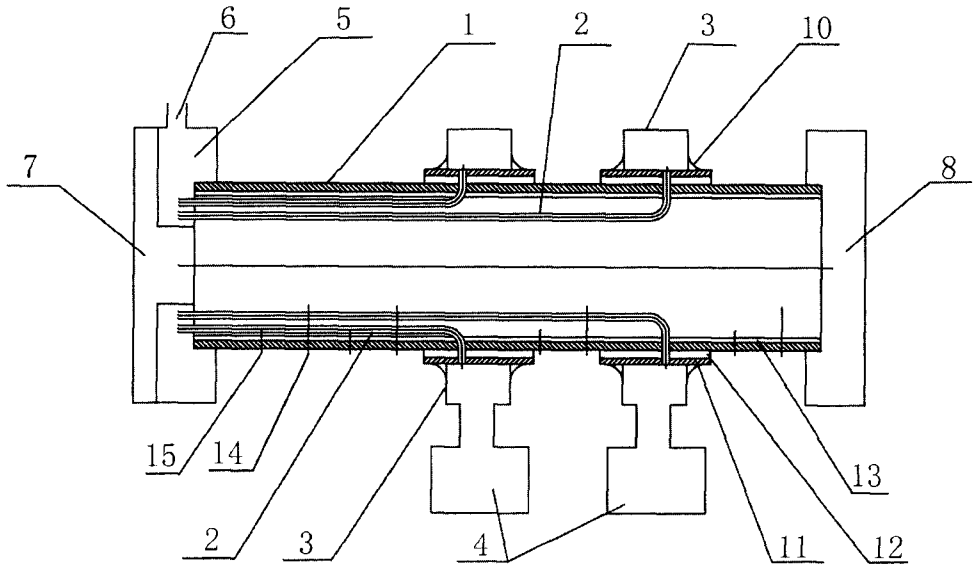


FIG. 3

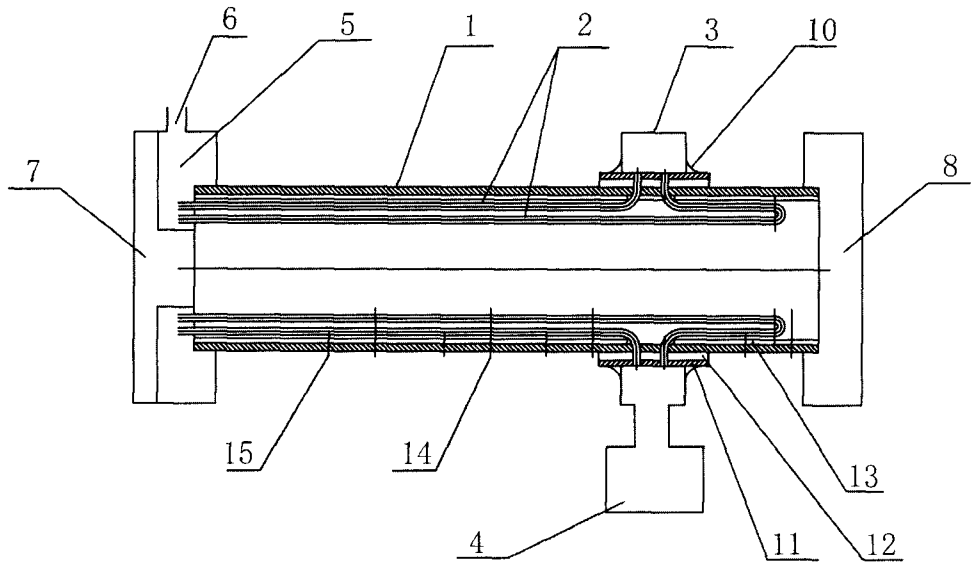
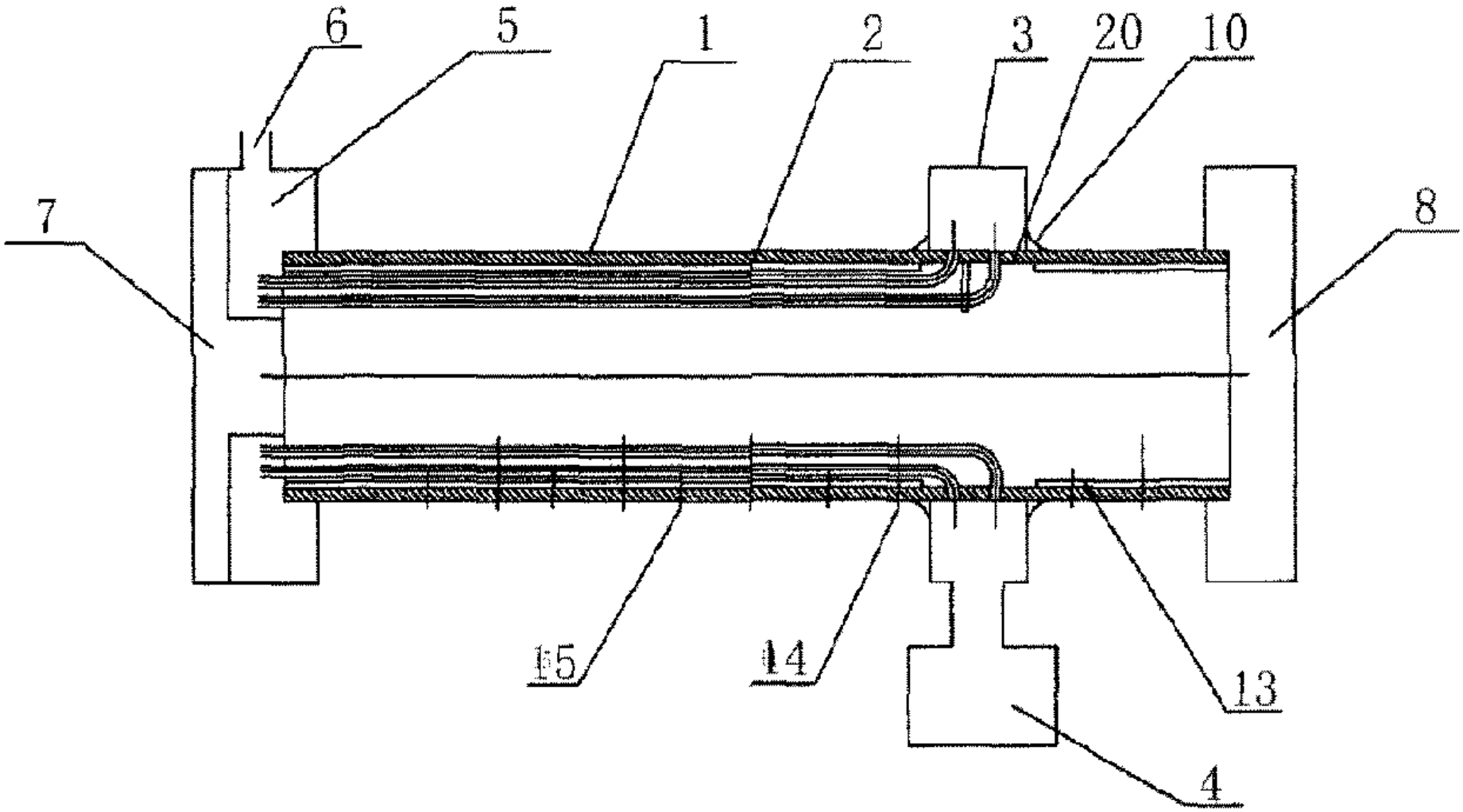


FIG. 4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