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(71) Applicant: **Bo, Hongmei**
Shenzhen, Guangdong 518000 (CN)

(72) Inventor: **Bo, Hongmei**
Shenzhen, Guangdong 518000 (CN)

(74) Representative: **Johnson, Richard Alan et al**
Mewburn Ellis LLP
City Tower
40 Basinghall Street
London EC2V 5DE (GB)

(54) STIRRING APPARATUS FOR SYNTHETIC PARTICLES AND HEATING METHOD THEREFOR

(57) Disclosed are a stirring apparatus for synthetic particles and a heating method therefor. The stirring apparatus for synthetic particles comprises: a rotatable stirring barrel (230); a fixed support (240) for supporting the stirring barrel (230); at least one heat conducting tube (210), wherein the side wall of the heat conducting tube (210) for facing a heat source is provided with multiple hot air inlet holes (211); a main heat conducting tube (220), wherein the main heat conducting tube (220) is in communication with an inner cavity of the stirring barrel (230), and the main heat conducting tube (220) is in communication with the heat conducting tube (210) to form a connected air channel; and an air pressure valve (250), wherein the air pressure valve (250) is arranged in the connected air channel. The heating method comprises: by means of a heat conducting tube (210) provided with hot air inlet holes (211), sucking hot air around a heat source into a connected air channel formed by connecting a main heat conducting tube (220) and the heat conducting tube (210); and bringing the main heat conducting tube (220) into communication with an inner cavity of a stirring barrel (230), so that the hot air is introduced into the rotatable stirring barrel (230) via the main heat conducting tube (220).

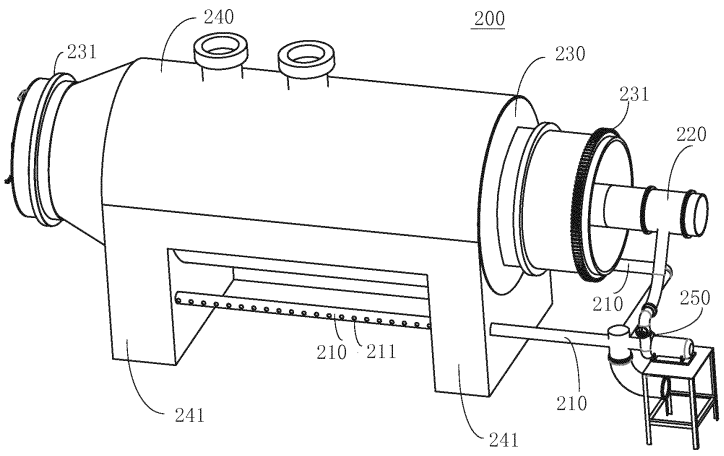

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a heating and mixing technology for composite particles, and more particularly, relates to a mixing plant for composite particles and a heating method of the mixing plant.

BACKGROUND

[0002] In the present global power stations, a requirement of the coal for the power generating boiler is extreme greater. However, when burning, the fossil fuel such as coal discharges a large quantity of gas which causes a greenhouse effect and a large quantity of dust which cannot be eliminated. Therefore, a new green power "biofuel" is adopted to replace the fossil fuel such as the traditional coal. The biofuel is transferred from condensed residual waste plant fiber of plants in general or commercial crops, such as halm, straw, weed tree, palm kernel shell, or coconut shell.

[0003] However, a conventional plant for composite particles generally requires a heating to the material therein. The conventional heating methods includes: providing an electric heating tube in the mixing tank, performing a steaming and baking treatment to the whole mixing tank, and so on. However, such treatments may results problems such as a poor temperature controllability, an uneven heat to the material in the mixing tank, and a high improvement cost. Therefore, the prior mixing plant for composite particles requires a further improvement to the heating method.

SUMMARY

[0004] Accordingly, it is necessary to provide a mixing plant for composite particles and a heating method of the mixing plant, which are directed to solve the problem of an uneven heating of the material in the mixing tank in the prior art.

[0005] A mixing plant for composite particles, includes: a rotatable mixing tank having an inner chamber; a fixing bracket for supporting the mixing tank; at least one heat conductive pipe, wherein the heat conductive pipe defines a plurality of hot air entrance holes on a sidewall thereof facing a heat source ***defining;*** a primary heat conductive pipe in communication with the inner chamber, wherein the primary heat conductive pipe is in communication with the heat conductive pipe to form an air communication passage; and a pneumatic valve located in the air communication passage.

[0006] In aforementioned mixing plant for composite particles, by providing a heat conductive pipe which defines a plurality of hot air entrance holes, the hot air close to a heat source is inhaled into an air communication passage constituted by the primary heat conductive pipe and the heat conductive pipe. When the primary heat conductive pipe is in communication with an inner chamber of the mixing tank, the hot air is introduced into the rotatable mixing tank by the primary heat conductive pipe, thereby achieving a heating, the heating method can provide a more homogeneous heating, and further causes the temperature in the mixing tank to be raised gradually, and enhances a controllability of the temperature in the mixing tank without additionally adding an electric heat tube circuit. An improvement cost for adding a heating function to the plant which does not have a heating function is low. In addition, a heat conduction and heat treatment of the whole mixing tank is eliminated, thereby a negative effect that causes damage to the housing of the mixing tank is avoided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] To illustrate the technical solutions according to the embodiments of the present invention or in the prior art more clearly, the accompanying drawings for describing the embodiments or the prior art are introduced briefly in the following. Apparently, the accompanying drawings in the following description are only some embodiments of the present invention, and persons of ordinary skill in the art can derive other drawings from the accompanying drawings without creative efforts

FIG. 1 is a perspective view of a plant according to one embodiment;
FIG. 2 is a plan view of a plant according to one embodiment;
FIG. 3 is a side view of a plant according to one embodiment;
FIG. 4 is a cross-sectional view, taken along line A-A of FIG. 3;
FIG. 5 is a cross-sectional view, taken along line B-B of FIG. 3;
FIG. 6 is a perspective view showing an internal of a mixing tank according to one embodiment;
FIG. 7 is a side view of a mixing tank according to an embodiment;
FIG. 8 is a top view of a plant according to an embodiment; and
FIG. 9 is a cross-sectional view, taken along line A-A of FIG. 8.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0008] Embodiments of the invention are described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. The various embodiments of the invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

[0009] It will be understood that when an element is referred to as being "fixed" to another element, it can be directly fixed to the other element or intervening elements may be present. When an element is referred to as being "connected" or "coupled" to another element, it can be directly connected or coupled to the other element or intervening elements may be present. The terminology "perpendicular", "horizontal", "left", "right" and similar expressions herein are for the purpose of illustration, and not for a unique implemented mode.

[0010] Unless otherwise defined, all terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Terms in the description of the ***connector*** are for the purpose of describing specific embodiments, and are not intend to limit the invention. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0011] As shown in FIG. 1, a mixing plant 200 for composite particles is provided according to one embodiment, the plant 200 includes a rotatable mixing tank 230, a fixing bracket 240 for supporting aforementioned mixing tank 230, at least one heat conductive pipe 210, a primary heat conductive pipe 220, and a pneumatic valve 250.

[0012] The mixing tank 230 can be driven to rotate by a motor. For example, in one embodiment, opposite ends of the mixing tank 230 are provided with tooth discs 231. The tooth disc 231 is arranged along a peripheral direction of the end of the mixing tank 230. The tooth disc 231 is connected to the motor via a gear transmission mechanism. After an electric drive, the mixing tank 230 is driven by the gear transmission mechanism to realize a rotation around a central axis of the mixing tank 230, thereby accomplishing a stirring of the materials in an inner chamber of the mixing tank.

[0013] In the illustrated embodiment, aforementioned heat conductive pipe 210 defines a plurality of hot air entrance holes 211 on a sidewall thereof facing a heat source. The primary heat conductive pipe 220 is in communication with an inner chamber of the mixing tank 230. The primary heat conductive pipe 220 is in communication with the heat conductive pipe 210, the primary heat conductive pipe 220 and the heat conductive pipe 210 constitute an air communication passage. The pneumatic valve 250 is located in the air communication passage. The pneumatic valve 250 is configured to control an atmospheric pressure. When the atmospheric pressure in the air communication passage is too great, it can be detected by the pneumatic valve 250, and the pneumatic valve 250 is initiated to perform a decompression to the atmospheric pressure.

[0014] It shows that, in one embodiment, hot air close to a heat source can be inhaled into the air communication passage by the heat conductive pipe, and is introduced into the rotatable mixing tank by the primary heat conductive pipe, thereby achieving a heating, such heating method can provide a more homogeneous heating, and provide a drying treatment for the wet materials in the mixing tank. The heat source mentioned here can be any devices which can provide a high temperature gas, such as a heating furnace.

[0015] As shown in FIG. 1 and FIG. 2, on basis of the structural foundation of above embodiment, in one embodiment, the fixing bracket 240 includes at least two supporting walls 241, the supporting wall 241 defines a fixing hole which is provided for the at least one heat conductive pipe 210 extending through and fixing the heat conductive pipe to the fixing bracket 240. The plurality of hot airs 211 are defined on a portion of the heat conductive pipe 210 which is located between the two supporting walls 241. The two supporting walls 241 support the mixing tank 230 to create a distance from a supporting surface (e.g. the ground surface), the heat source (e.g. the heating furnace) is located within the distance, an occupying space can be saved, causing the plant to have a more compact structure.

[0016] In addition, in order to conveniently inhale the air or diffuse the air in the air communication passage, in one embodiment, both the primary heat conductive pipe 220 and the heat conductive pipe 210 have hollow tubular shapes. And/or the primary heat conductive pipe 220 and the heat conductive pipe 210 are parallel arranged. For example, the primary heat conductive pipe 220 is arranged parallel to an axis of the mixing tank 230. The hollow tubular shape mentioned here in the illustrated embodiment can be a hollow tubular structure which has a cross-section of any shape, such as a hollow circular tube, a hollow tube having a trapezoidal cross-section, a hollow elliptical tube, a hollow square tube.

[0017] In order to accelerate a diffusion of the hot air in the mixing tank, as shown in FIG. 1 through FIG. 3, in one embodiment, both the primary heat conductive pipe 220 and the heat conductive pipe 210 are hollow circular tubes. A diameter of the primary heat conductive pipe 220 is greater than a diameter of the heat conductive pipe. Apparently, the primary heat conductive pipe 220 can also adopt a structure which has a plurality of heat exchange tubes. For example, a plurality of heat exchange tubes are located in the mixing tank to form a primary radiating tube, the plurality of heat exchange tubes are in communication with the heat conductive pipe 210 to form the air communication passage.

[0018] In addition, in order to constantly heat the material in the mixing tank in a rotation process of the mixing tank, as shown in FIG. 3 through FIG. 5, in one embodiment, an end of the mixing tank 230 is provided with a sealing cover 280. The sealing cover 280 defines a through hole thereon. The primary heat conductive pipe 220 extends through the through hole and into the mixing tank 230. The through hole of the sealing cover 280 is connected to the primary heat conductive pipe 220 via a bearing 270. In the illustrated embodiment, when the mixing tank 230 rotates, a rotation of the mixing tank 230 can be separated from the primary heat conductive pipe 220 by a limitation of the bearing 270, a following move-

ment of the primary heat conductive pipe 220 accompanying to the mixing tank 230 can be avoided. Apparently, in other embodiments, the primary heat conductive pipe is linked to the sealing cover 280 of the mixing tank for moving.

[0019] As shown in FIG. 4 through FIG. 6, on basis of the structural foundation of any one aforementioned embodiment, in one embodiment, an end of the primary heat conductive pipe 220 extends into the mixing tank 230, and a portion of the primary heat conductive pipe 220 which extends into the mixing tank 230 defines at least one row of hot air exhaust holes 221 along a longitudinal direction. The at least one row of hot air exhaust holes 221 is arranged along a longitudinal direction of the primary heat conductive pipe 220. Apparently, the portion of the primary heat conductive pipe 220 which extends into the mixing tank 230 can also define at least one loop of hot air exhaust holes 221 along a peripheral direction. The pluralities of hot air exhaust holes 221 are mainly arranged to diffuse the hot air into the mixing tank rapidly, causing a heating to be more homogeneous.

[0020] As shown in FIG. 1 through FIG. 9, in one embodiment, a vertical height of the at least one heat conductive pipe is less than a vertical height of the primary heat conductive pipe. The vertical height mentioned here indicates a distance between an axis of the heat conductive pipe or an axis of the primary heat conductive pipe and the supporting surface (e.g. the ground surface). In the illustrated embodiment, a hot air self-diffusion principle can be utilized to enable the hot air to be delivered and diffused automatically in the air communication passage, without adopting external force to diffuse the hot air in the air communication passage.

[0021] As shown in FIG. 5 through FIG. 9, on basis of the structural foundation of any one aforementioned embodiment, in one embodiment, the air communication passage defines an exhaust through hole 291 and includes a first connecting tube 293, a second connecting tube 292, the at least one heat conductive pipe 210, and the primary heat conductive pipe 220. The at least one heat conductive pipe 210 is in communication with the first connecting tube 293. The first connecting tube 293 is in communication with the exhaust through hole 291. The first connecting tube 293 is further in communication with the primary heat conductive pipe 220 via the second connecting tube 292. The pneumatic valve 250 is positioned on the second connecting tube 292. The first connecting tube 293 is a four-way adapter coupling, or a multi-way adapter coupling. In addition, as shown in FIG. 9, the first connecting tube 293 and the second connecting tube 292 can be fixed or supported by the bracket 260, so as to fixedly support an air communitarian passage assembly outside of the mixing tank 230.

[0022] As shown in FIG. 5 and FIG. 6, on basis of the structural foundation of any one aforementioned embodiment, in one embodiment, in order to accelerate a flowing of the hot air in the air communication passage, the plant further includes an air pump (not shown), the air pump is connected to the air communication passage, and configured to pump the hot air close to the heat source into the at least one heat conductive pipe via the hot air entrance holes, i.e. a negative pressure can be generated in the at least one heat conductive pipe by the air pump, thereby causing the hot air close to the heat source to be quickly inhaled into the at least one heat conductive pipe.

[0023] As shown in FIG. 4 and FIG. 5, on basis of the structural foundation of any one aforementioned embodiment, in one embodiment, the mixing tank 230 further includes a plurality of elongated members 232. The plurality of elongated members 232 are arranged along an inner wall of the mixing tank 230 and spaced from each other, and the plurality of elongated members 232 are arranged in a spiral shape. Angles between each elongated member 232 and the axis of the mixing tank 230 are the same. Each elongated member 232 extends from an end of the mixing tank 230 to an opposite end of the mixing tank 230. When the mixing tank 230 rotates, the elongated member 232 follows and rotates to generate a wind force which blows into an inner of the mixing tank 230 and inhales composite particles from the entrance holes into the inner. When the mixing tank 230 rotates reversely, the elongated member 232 follows and rotates to generate a wind force which blows outside the mixing tank 230, and composite particles are outputted from outlets.

[0024] In order to solve the problem of an uneven heat of the material in the mixing tank in the prior art, in one embodiment, a mixing plant for composite particles is provided. By providing a heat conductive pipe which defines a plurality of hot air entrance holes, the hot air close to a heat source is inhaled into an air communication passage constituted by the primary heat conductive pipe and the heat conductive pipe. When the primary heat conductive pipe is in communication with an inner chamber of the mixing tank, the hot air is introduced into the rotatable mixing tank by the primary heat conductive pipe, thereby achieving a heating, the heating method can provide a more homogeneous heating, and further causes the temperature in the mixing tank to be raised gradually, and enhances a controllability of the temperature in the mixing tank without additionally adding an electric heat tube circuit. An improvement cost for adding a heating function to the plant which does not have a heating function is low. In addition, a heat conduction and heat treatment of the whole mixing tank is eliminated, thereby a negative effect that causes damage to the housing of the mixing tank is avoided.

[0025] Technical features of above embodiments can be combined arbitrarily, for simple, any combination of every technical feature in above embodiments is not all illustrated. However, the technical features which are not contradicted to each other may fall into the scope of the specification.

[0026] Based upon aforementioned plant, in one embodiment, a heating method of a mixing tank for compos-

ite particles is provided, which includes: hot air close to the heat source is sucked into an air communication passage constituted by the primary heat conductive pipe and the heat conductive pipe, by providing a heat conductive pipe which defines a plurality of hot air entrance holes; the primary heat conductive pipe is in communication with an inner chamber of the mixing tank, thereby the hot air is introduced into the rotatable mixing tank by the primary heat conductive pipe. The structural configuration of the heat conductive pipe and the primary heat conductive pipe can be referred from aforementioned related illustration, and is not specific illustrated herein.

[0027] The above are several embodiments of the present invention described in detail, and should not be deemed as limitations to the scope of the present invention. It should be noted that variations and improvements will become apparent to those skilled in the art to which the present invention pertains without departing from its spirit and scope. Therefore, the scope of the present invention is defined by the appended claims.

Claims

1. A mixing plant for composite particles, comprising:

a rotatable mixing tank having an inner chamber;
a fixing bracket for supporting the mixing tank;
at least one heat conductive pipe, wherein the heat conductive pipe defines a plurality of hot air entrance holes on a sidewall thereof facing a heat source;
a primary heat conductive pipe in communication with the inner chamber, wherein the primary heat conductive pipe is in communication with the heat conductive pipe to form an air communication passage; and
a pneumatic valve located in the air communication passage.

2. The plant according to claim 1, wherein the fixing bracket has at least two supporting walls, the supporting wall defines a fixing hole which is provided for the at least one heat conductive pipe extending through and fixing the heat conductive pipe to the fixing bracket, and the plurality of hot air entrance holes are defined on a portion of the heat conductive pipe which is located between the two supporting walls.

3. The plant according to claim 1, wherein both the primary heat conductive pipe and the heat conductive pipe have hollow tubular shapes, and/or the primary heat conductive pipe and the heat conductive pipe are parallel arranged.

4. The plant according to claim 1, wherein a diameter of the primary heat conductive pipe is greater than a diameter of the heat conductive pipe.

5. The plant according to claim 1, wherein an end of the mixing tank is provided with a sealing cover, the sealing cover defines a through hole thereon, the primary heat conductive pipe extends through the through hole and into the mixing tank, the primary heat conductive pipe is located in the through hole of the sealing cover via a bearing.

6. The plant according to claim 1, wherein an end of the primary heat conductive pipe extends into the mixing tank, and a portion of the primary heat conductive pipe which extends into the mixing tank defines at least one row of hot air exhaust holes arranged along a longitudinal direction, or a portion of the primary heat conductive pipe which extends into the mixing tank defines at least one loop of hot air exhaust holes along a peripheral direction.

7. The plant according to claim 1, wherein a vertical height of the at least one heat conductive pipe is less than a vertical height of the primary heat conductive pipe.

8. The plant according to claim 1, wherein the air communication passage further defines an exhaust through hole, the at least one heat conductive pipe is in communication with the first connecting tube, the first connecting tube is in communication with the exhaust through hole, and the first connecting tube is further in communication with the primary heat conductive pipe via the second connecting tube, the pneumatic valve is located on the second connecting tube.

9. The plant according to claim 1, further comprising an air pump, wherein the air pump is connected to the air communication passage, and configured to pump hot air close to a heat source into the at least one heat conductive pipe via the hot air entrance holes

10. A heating method of a mixing tank for composite particles, comprising:

inhaling hot air close to a heat source into an air communication passage which is constituted by a primary heat conductive pipe and a heat conductive pipe, by providing a heat conductive pipe which defines a plurality of hot air entrance holes; and
communicating the primary heat conductive pipe with an inner chamber of the mixing tank, thereby introducing the hot air into the rotatable mixing tank by the primary heat conductive pipe.

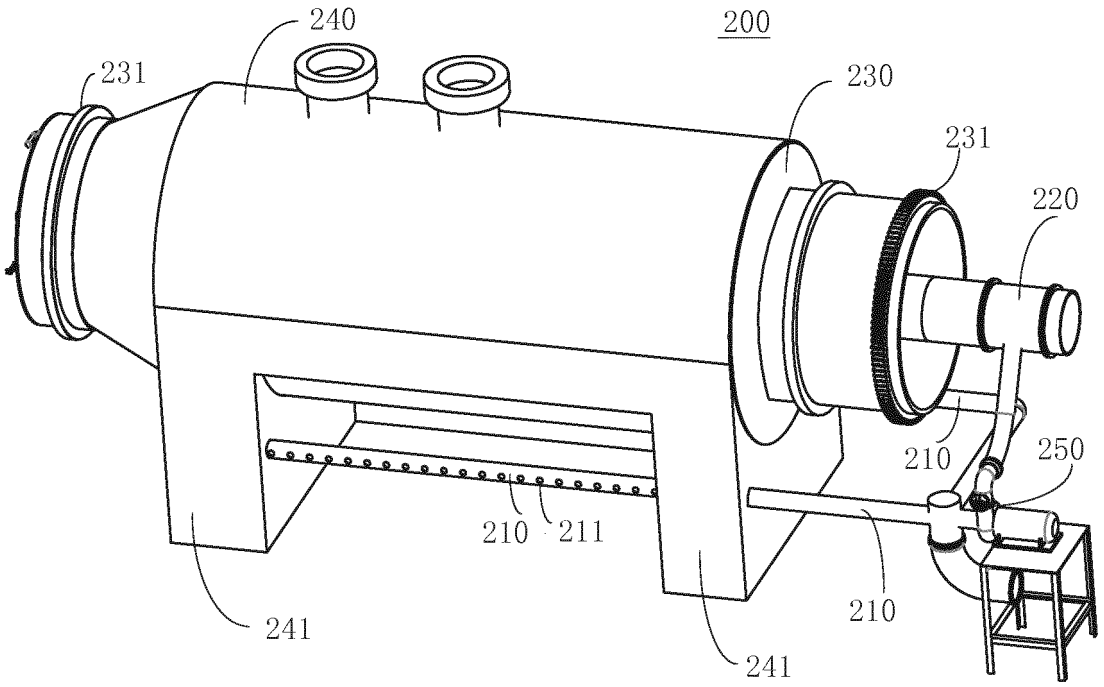

FIG. 1

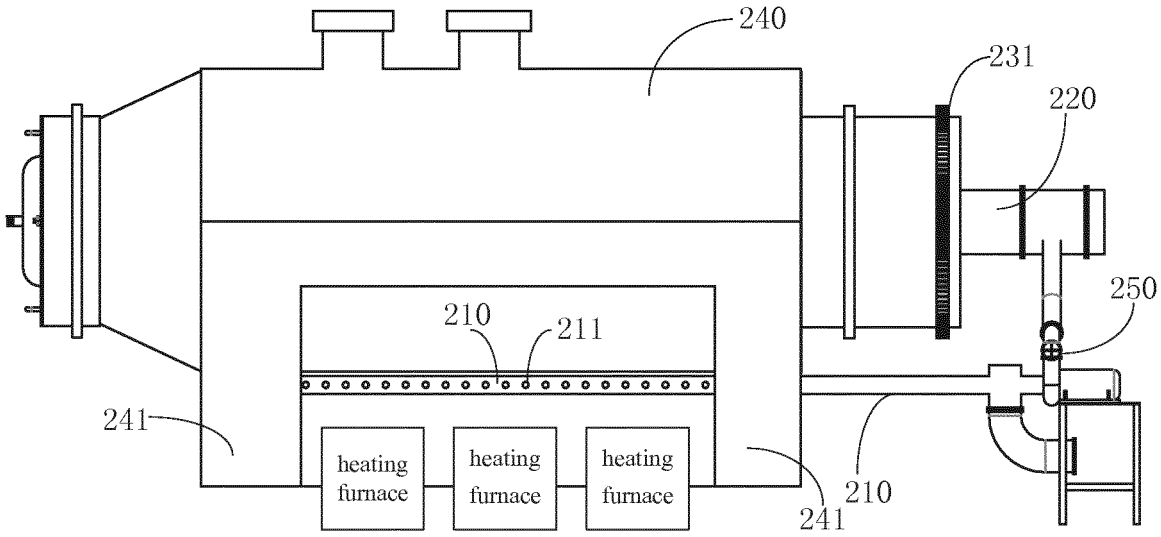
240
231
220
250
210
211
241
heating furnace
heating furnace
heating furnace
210
241

FIG. 2

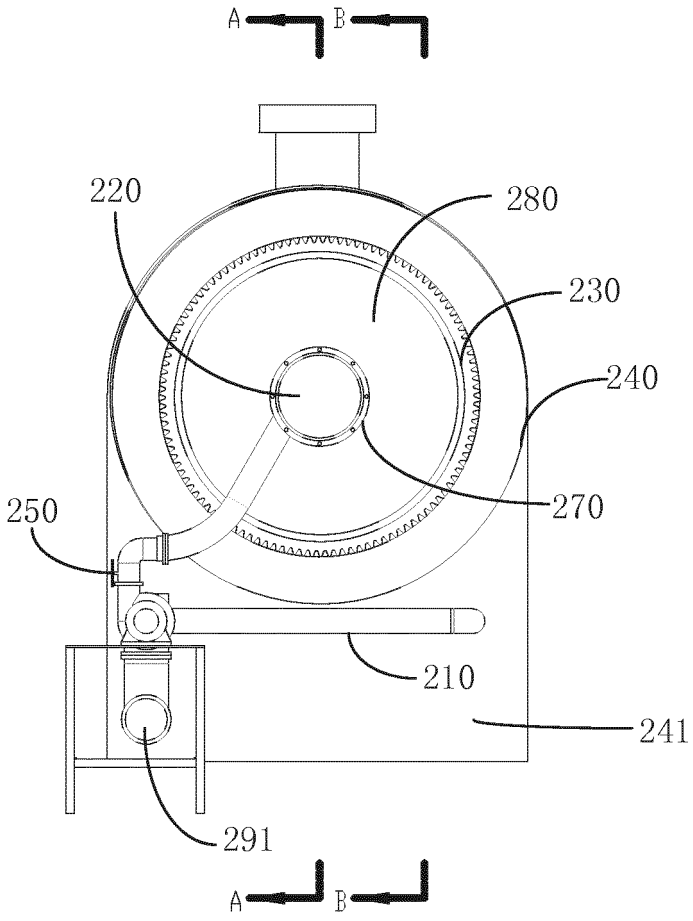

FIG. 3

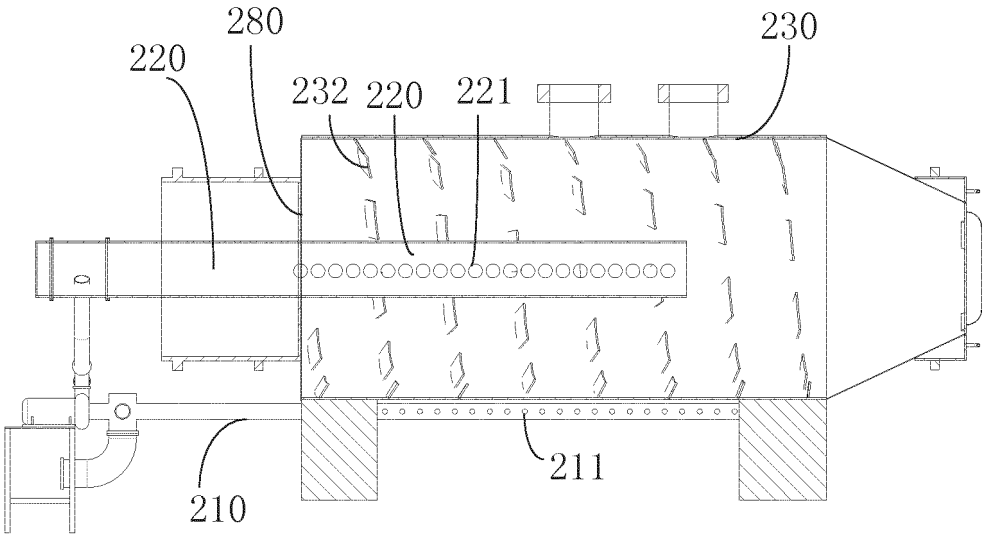

FIG. 4

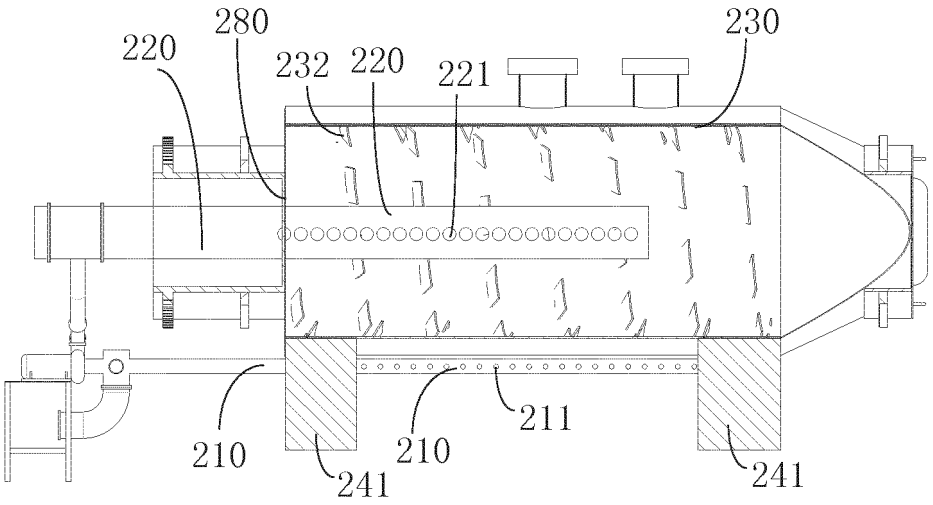

FIG. 5

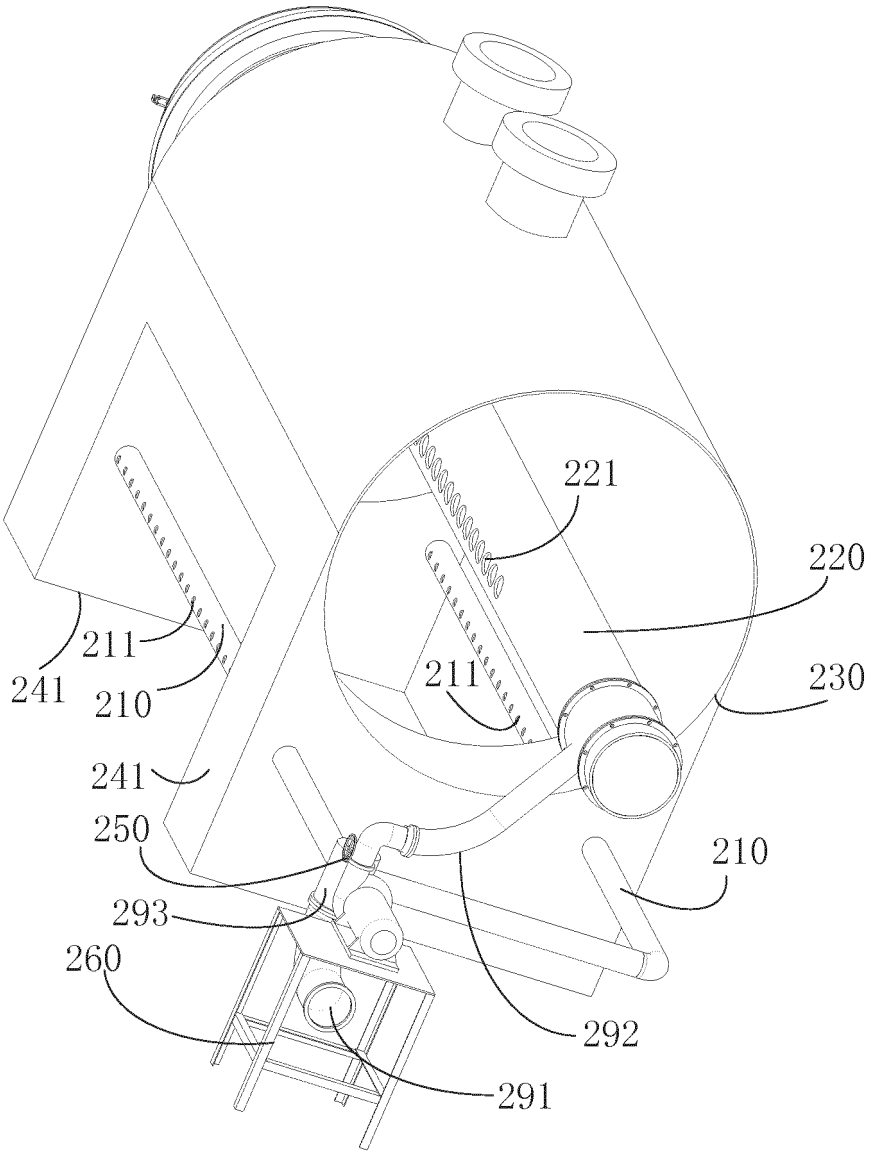

FIG. 6

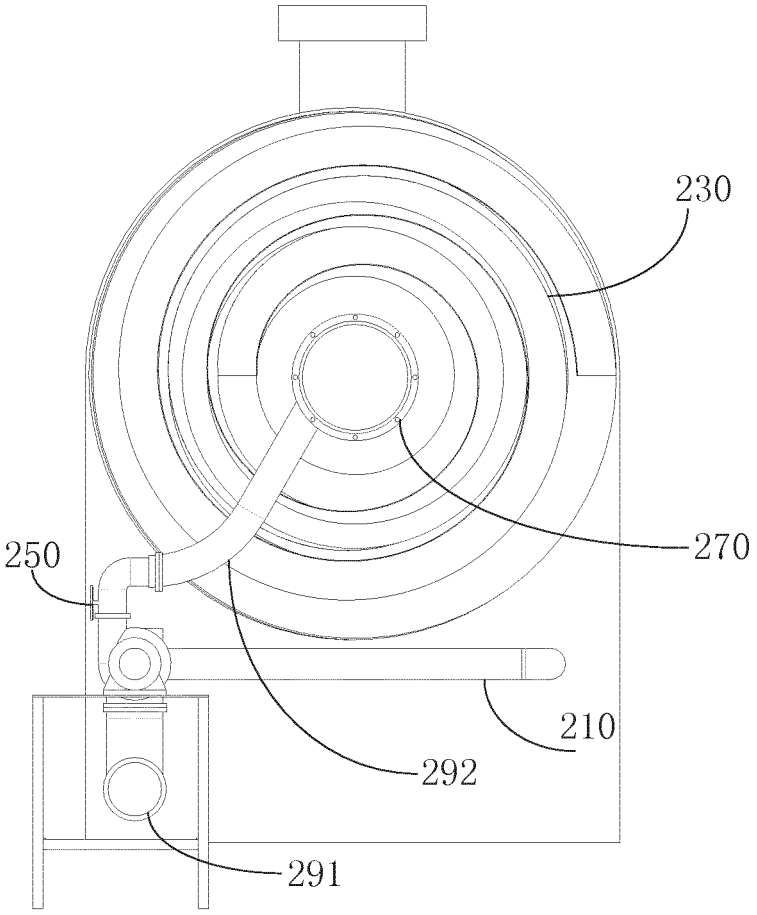

FIG. 7

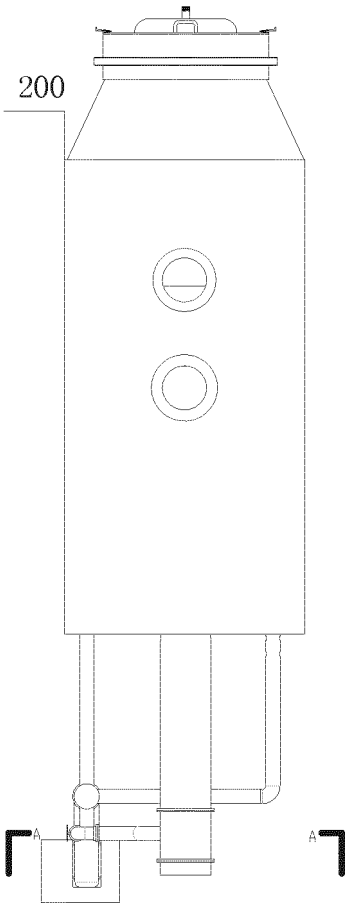

FIG. 8

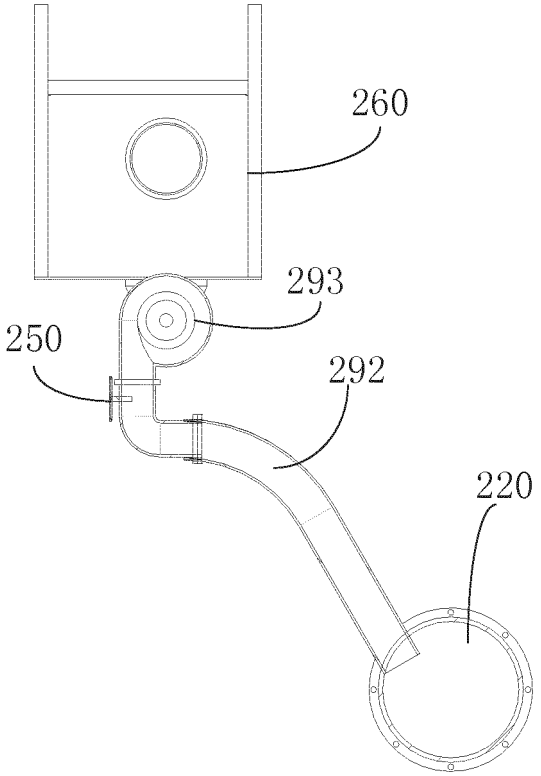

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2016/105367

A. CLASSIFICATION OF SUBJECT MATTER

B01F 9/00 (2006.01) i; B01F 15/06 (2006.01) i
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNTXT; CNABS; WPI; EPODOC: rotate, rotary drum, heating, stir, rotatable, heat conduct, hot air, dry, hole

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 2123046 U (HU, Jian'guo), 25 November 1992 (25.11.1992), description, pages 2-3, claims 1-4, and figure 1	1-10
X	CN 2237823 Y (YAN, Guangcai), 16 October 1996 (16.10.1996), description, page 2, and figures 1-2	1-10
PX	CN 105268354 A (BAI, Hongmei), 27 January 2016 (27.01.2016), particular embodiments	1-10
PX	CN 205182601 U (BAI, Hongmei), 27 April 2016 (27.04.2016), particular embodiments	1-10
A	CN 203635126 U (YUMEN YUHAI ENERGY DEVELOPMENT CO., LTD.), 11 June 2014 (11.06.2014), the whole document	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 December 2016 (15.12.2016)	**29 December 2016 (29.12.2016)**
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer **QIANG, Jing** Telephone No.: (86-10) **62414380**

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2016/105367

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 2123046 U	25 November 1992	None	
CN 2237823 Y	16 October 1996	None	
CN 105268354 A	27 January 2016	None	
CN 205182601 U	27 April 2016	None	
CN 203635126 U	11 June 2014	None	

Form PCT/ISA/210 (patent family annex) (July 2009)