(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 488 580 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
08.01.2025 Bulletin 2025/02

(21) Application number: **24212261.2**

(22) Date of filing: **25.03.2022**

(51) International Patent Classification (IPC):
F23D 14/10 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F24H 1/0027; F23D 14/045; F23D 14/105; F23D 14/145; F23D 14/26; F23D 14/58;
F23D 2203/103; F23D 2212/201; F23D 2213/00; F24H 9/18; F24H 9/1836

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **25.03.2021 CN 202120612600 U**

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
22774353.1 / 4 273 449

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Remarks:
This application was filed on 12.11.2024 as a divisional application to the application mentioned under INID code 62.

(54) **FIRE GRATE AND MANUFACTURING METHOD THEREOF, BURNER AND WATER HEATER**

(57) A burner bar (10), a manufacturing method therefor, a burner and a water heater applying the burner bar. The burner bar (10) comprises a burner bar body (100), aflame stabilizing apparatus (200), and a metal mesh (300). The burner bar body (100) forms a ventilating channel (110). A diverting hole (120) in communication with the ventilation channel (110) is provided at the top section (130) of the burner bar body (100). The flame stabilizing apparatus (200) is provided at the upper section of the burner bar body (100). The flame stabilizing apparatus (200) is provided therein with a cavity (210) having an opening (211) on the top side. A gap (212) is provided between the sidewall of the cavity (210) and the surface of the burner bar body (100). The gap (212) is in communication with the ventilation channel (110). The metal mesh (300) is affixed at the position corresponding to the diverting hole (120) to the burner bar body (100). The metal mesh (300) and the flame stabilizing apparatus (200) provide double flame stabilizing effects and increase the range of adaptability to single-piece heat load burning, the area of the aperture of the diverting hole (120) is increased, the performance of instant burning and flue gas discharging is great, and the usage requirement for an overall low nitrogen emission is satisfied.

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims a priority to Chinese Patent Application No. 202120612600.9, filed on March 25, 2021, and entitled "Flame-dividing device, burner and water heating equipment", the disclosure of which is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The disclosure relates to a technical field of fluid heating equipment, in particular to a fire grate and a manufacturing method thereof, a burner and a water heater.

BACKGROUND

[0003] In the related art, a burner is a core component of a water heater. An existing burner of the water heater may use fully premixed combustion technology, rich-lean combustion technology or water-cooling combustion technology in terms of low nitrogen oxides combustion technology, while a structure of fire port of the existing burner usually adopts a single strip-shaped structure of fire port. Due to a small area of fire port of the single strip-shaped structure of fire port, a burning intensity of the fire port is high, and a performance of a flue gas emitted by instantly combusted fuels is not good, resulting in that a content of nitrogen oxides is high, and performance requirements of low nitrogen emission cannot be met. Thus, it is necessary to improve a structure of a fire grate of the existing burner. CN 111 735 206 A discloses a household gas-water-heater which is equipped with a burner. US 2018/0087772 A1 relates to a combustor including a pipe and a burner tray, while CN 106 765 085 A relates to a combustor used for a gas-water-heater.

SUMMARY

[0004] The main purpose of the present invention is to propose a fire grate, aiming to solve a technical problem that a content of nitrogen oxides contained in a flue gas is relatively high due to an insufficient combustion of combustion gas in a burner, causing relatively great pollution to the environment.

[0005] In orderto achieve the above object, the fire grate proposed by the present invention may comprise:

a fire grate body, formed with a ventilation channel, a top portion of the fire grate body being provided with a dividing hole communicating with the ventilation channel;
a flame stabilizing device, sleeved on an upper portion of the fire grate body, a cavity with a top surface as an opening being formed within the flame stabilizing device, a gap being formed between a side wall of the cavity and a surface of the fire grate body, and the gap being in communication with the ventilation channel; and
a metal mesh, attached onto the fire grate body at a position corresponding to the dividing hole, wherein the mesh number of the metal mesh ranges from 20 meshes to 100 meshes.

[0006] In an embodiment, there are multiple layers of metal meshes.

[0007] In an embodiment, the metal mesh is located below the dividing hole.

[0008] In an embodiment, the dividing hole comprises a plurality of first dividing holes and a plurality of second dividing holes, an open area of the first dividing hole being larger than an open area of the second dividing hole.

[0009] In an embodiment, the plurality of first dividing holes and the plurality of the second dividing holes are arranged at an interval along a length direction of the top portion of the fire grate body.

[0010] In an embodiment, the plurality of first dividing holes and the plurality of the second dividing holes are alternately arranged at an interval along a length direction of the top portion of the fire grate body.

[0011] In an embodiment, the second dividing hole comprises a plurality of sub-dividing holes, the plurality of sub-dividing holes being arranged along a width direction of the top portion of the fire grate body.

[0012] In an embodiment, the flame stabilizing device is also provided with a reinforcement rib at the opening. The reinforcement rib is fixedly connected to the metal mesh, or the reinforcement rib is fixedly connected to the top portion of the fire grate body.

[0013] In an embodiment, an edge of at least one layer of metal mesh is bent to form a bent part.

[0014] In an embodiment, the top portion of the fire grate body is plate-shaped, the fire grate body having two side plates extending from the top portion to a same side of the top portion, the ventilation channel being formed between the two side plates, the side plate having a gas outlet thereon to communicate the ventilation channel to the gap.

[0015] In an embodiment, there are a plurality of gas outlets, a plurality of the gas outlets being arranged at an interval

on the side plate along the length direction of the top portion of the fire grate body.

[0016] In an embodiment, a flow passing area at the gas outlet gradually increases from the ventilation channel to the gap.

[0017] The disclosure also discloses a manufacturing method of a fire grate, and the manufacturing method of a fire grate comprises the following steps:

preparing a metal plate, a metal mesh and a flame stabilizing sheet;
shaping the metal plate to form a fire grate body with a ventilation channel and a dividing hole, the dividing hole being located at a top portion of the fire grate body and in communication with the ventilation channel;
shaping the flame stabilizing sheet to form a flame stabilizing device which has a cavity with a top surface as an opening;
fixing the metal mesh onto the fire grate body at a position corresponding to the dividing hole; or fixing the metal mesh onto the flame stabilizing device at a position corresponding to the dividing hole; and
sleeving the flame stabilizing device on an upper portion of the fire grate body.

[0018] In an embodiment, the step of shaping the metal plate to form a fire grate body with a ventilation channel and a dividing hole, the dividing hole being located at a top portion of the fire grate body and in communication with the ventilation channel comprises:

bending two ends of the metal plate to a same side of the metal plate to form the top portion of the fire grate body and the two side plates which extend from the top portion to the same side of the top portion; before the plate is bent, the dividing hole is punched out at a position corresponding to the top portion, or after the metal plate is bent, the dividing hole is punched out at the top portion; and
stamping the two side plates to form the ventilation channel between the two side plates.

[0019] In an embodiment, the step of stamping the two side plates to form the ventilation channel between the two side plates comprises:

stamping corresponding positions of the two side plates according to a preset shape of the ventilation channel; and
snapping the two side plates after edges of other three sides of the two side plates are cut, and causing an edge of one side plate of the two side plates to be wrapped with an edge of other side plate after snapping.

[0020] In an embodiment, before stamping the two side plates to form the ventilation channel between the two side plates, the following step is further comprised:
forming a gas outlet at a preset position of the two side plates, to cause the ventilation channel to be in communication with the gap after the flame stabilizing device is sleeved on the upper portion of the fire grate body.

[0021] The present invention also discloses a burner and a water heater comprising the burner. The burner comprises the aforementioned fire grate. The fire grate comprises a fire grate body, a flame stabilizing device and a metal mesh. The fire grate body is formed with a ventilation channel. A top portion of the fire grate body is provided with a dividing hole communicating with the ventilation channel. An opening corresponds to the dividing hole. The flame stabilizing device is sleeved on an upper portion of the fire grate body. A cavity with a top surface as an opening is formed within the flame stabilizing device. The metal mesh is attached onto the fire grate body at a position corresponding to the dividing hole.

[0022] In technical solutions of the present invention, the top portion of the fire grate is provided with a structure of fire port and a flame stabilizing device, and the structure of fire port is formed by combining the dividing hole with a larger open area and the metal mesh. By increasing the open area of the dividing hole, a flue gas emission performance of instant combustion can be better, and the nitrogen oxides generated can be reduced. Furthermore, by adopting the metal mesh and the flame stabilizing device, a dual flame stabilizing effect can be formed, thus an adaptability range of a combustion thermal load of a single piece of fire grate can be increased, and the usage problem that a small load of the adaptability range of the combustion thermal load of the single piece of fire grate cannot be lowered can be solved. The number of segments of the fire grate 10 can be reduced, thus a simple structure, a convenient manufacture, and a low cost can be achieved. A usage requirement of a whole machine for low nitrogen emission can be met.

BRIEF DESCRIPTION OF DRAWINGS

[0023] In order to illustrate the technical solutions in the embodiments of the present invention or the related arts more clearly, the following will briefly introduce the accompanying drawings that need to be used in the description of the embodiments or the related arts. Obviously, the accompanying drawings in the following description are only some

embodiments of the present invention, and those skilled in the art can also obtain other drawings according to the structures shown in these drawings without creative work.

FIG. 1 is a structural schematic diagram of a fire grate according to an embodiment of the present invention;
FIG. 2 is a side view of the fire grate in FIG. 1;
FIG. 3 is A-A sectional view of the fire grate in FIG. 1;
FIG. 4 is a schematic diagram of a flow direction of an airflow in FIG. 3;
FIG. 5 is another side view of the fire grate in FIG. 1;
FIG. 6 is a structural schematic diagram of another embodiment of a dividing hole in FIG. 5;
FIG. 7 is a structural schematic diagram of a burner according to an embodiment of the present invention;
FIG. 8 is a structural schematic diagram of a fire grate body in FIG. 1;
FIG. 9 is a side view of the fire grate body in FIG. 8;
FIG. 10 is a structural schematic diagram of another embodiment of the dividing hole in FIG. 9;
FIG. 11 is another side view of the fire grate body in FIG. 8;
FIG. 12 is a B-B sectional view of the fire grate body in FIG. 8;
FIG. 13 is another structural schematic diagram of a metal mesh in FIG. 12;
FIG. 14 is a structural schematic diagram of another embodiment of the fire grate body in FIG. 1;
FIG. 15 is a C-C sectional view of the fire grate body in FIG. 14;
FIG. 16 is another structural schematic diagram of the metal mesh in FIG. 15;
FIG. 17 is an enlarged view of a portion indicated by A in FIG. 16;
FIG. 18 is a structural schematic diagram of a flame stabilizing device in FIG. 1;
FIG. 19 is a side view of the flame stabilizing device in FIG. 18;
FIG. 20 is another side view of the fire grate body in FIG. 18;
FIG. 21 is a D-D sectional view of the flame stabilizing device in FIG. 18;
FIG. 22 is a schematic flow diagram of a manufacturing method of fire grate according to an embodiment of the present invention;
FIG. 23 is a schematic flow diagram of the manufacturing method of fire grate according to another embodiment of the present invention;
FIG. 24 is a schematic flow diagram of the manufacturing method of fire grate according to a further embodiment of the present invention;
FIG. 25 is a schematic flow diagram of the manufacturing method of fire grate according to a yet other embodiment of the present invention;
FIG. 26 is a structural schematic diagram of the fire grate according to another embodiment of the present invention;
FIG. 27 is a structural schematic diagram of the fire grate according to a further embodiment of the present invention;
FIG. 28 is a structural schematic diagram of the fire grate body in FIG. 26; and
FIG. 29 is C1-C1 sectional view of the fire grate body in FIG. 28.

Illustration of reference numbers:

[0024]

Reference number	Name	Reference number	Name
10	fire grate	122	second dividing hole
100	fire grate body	122a	sub-dividing hole
130	top portion of the fire grate body	200	flame stabilizing device
140	side plate	210	cavity
150	gas outlet	211	opening
110	ventilation channel	212	gap
120	dividing hole	220	reinforcement rib
121	first dividing hole	300	metal mesh
230	lateral convex hull	231	external convex hull
232	inner convex hull	240	flame guiding part

(continued)

Reference number	Name	Reference number	Name
201	flame stabilizing sheet	310	bent part

[0025] The realization, functional features and advantages of the disclosure will be further described in conjunction with the embodiments and with reference to the accompanying drawings.

DESCRIPTION OF EMBODIMENTS

[0026] The technical solutions in the embodiments of the present invention will be clearly and completely described below in conjunction with the accompanying drawings in the embodiments of the present invention. Obviously, the described embodiments are only part of the embodiments of the present invention, not all the embodiments. Based on the embodiments of the present invention, all other embodiments obtained by persons of ordinary skill in the art without making creative efforts belong to the scope of protection of the present invention.

[0027] It should be noted that, if there are directional indications in embodiments of the present invention, the directional indications are only used to explain a relative position relationship and/or a state of motion or the like among various components in a specific posture. If the specific posture changes, the directional indications will also change accordingly.

[0028] In addition, if there are descriptions involving "first", "second" etc. in the embodiments of the present invention, the descriptions of "first", "second", etc. are used only for a purpose of description and shall not be understood to indicate or imply their relative importance, or designate implicitly the number of technical features indicated. Therefore, the features defined with "first" and "second" may explicitly or implicitly comprise at least one of the features. In addition, if an expression of "and/or" appears throughout the text, its meaning comprises three parallel schemes. The expression of "A and/or B" is taken as an example, which comprises a scheme comprising A, or a scheme comprising B, or a scheme in which A and B are comprised at the same time. In addition, the technical solutions of the various embodiments can be combined with one another, but a technical solution combined by technical solutions of the various embodiments shall be capable of being realized by those skilled in the art. When a combination of technical solutions is contradictory or cannot be realized, it should be considered that the combination of technical solutions does not exist, and is not within a scope of protection sought for by the present invention.

[0029] In an embodiment of the present invention, as shown in FIG. 1 to FIG. 21, a fire grate 10 comprises: a fire grate body 100, a flame stabilizing device 200 and a metal mesh 300. The fire grate body 100 is formed with a ventilation channel 110, and a top portion 130 of the fire grate body 100 is provided with a dividing hole 120 communicating with the ventilation channel 110. The flame stabilizing device 200 is sleeved on an upper portion of the fire grate body 100, and a cavity 210 with a top surface as an opening 211 is formed within the flame stabilizing device 200. A gap 212 is formed between a side wall of the cavity 210 and a surface of the fire grate body 100, and the gap 212 is in communication with the ventilation channel 110. The metal mesh 300 is attached onto the fire grate body 100 at a position corresponding to the dividing hole 120.

[0030] In some embodiments, the fire grate 10 is mainly used on a burner, and the fire grate 10 is one of core components of the burner. In terms of the low nitrogen oxides combustion technology of a burner of combustion gas water heater, a structure of the fire grate 10 plays an important role. As far as the fire grate 10 is concerned, the fire grate 10 comprises a fire grate body 100, a flame stabilizing device 200 and a metal mesh 300. A ventilation channel 110 is formed within the fire grate body 100, and the ventilation channel 110 has a gas inlet. The gas inlet is usually connected to an airflow source, and the airflow source comprises an air and a combustion gas. The combustion gas and air enter the ventilation channel 110 from the gas inlet. The combustion gas and air are pre-mixed within the ventilation channel 110, then completely mixed and divided by the metal mesh 300 or the dividing hole 120, finally ignited at the top portion 130 of the fire grates 10, and then a stable and uniform flame is formed.

[0031] It should be noted that, in the embodiments of the present invention, in order to increase a thermal load of the fire grate 10 so that a range of adaptability of the fire grate 10 can be improved, and in turn a better performance flue gas emission of instant combustion is achieved, and finally a lower nitrogen oxides produced after the combustion is realized, an open area of the dividing hole 120 of the present invention is larger than that of an existing common thin and long strip-shaped dividing hole, and generally is between 5 times to 100 times than that of the current common dividing hole, exemplarily, comprising but not limited to 5 times, 6 times, 8 times, 10 times, 20 times, 30 times, 40 times, 50 times, 60 times, 70 times, 80 times, 90 times and 100 times. The dividing hole 120 may be of circular, ellipse, square or other regular or irregular shape designs. The following uses the square design as an example to introduce.

[0032] In some embodiments, in consideration of a larger open area of the dividing hole 120, in order to avoid a phenomenon of a backfire, a metal mesh is attached onto the fire grate body 100, and the metal mesh is arranged corresponding to the dividing hole 120. In some embodiments, considering that an open area of the metal mesh is large,

in order to prevent an explosion accident caused by the backfire, referring to FIG. 3, FIG. 12, and FIG. 15 to FIG. 17, there are multiple layers of metal meshes disposed. The number of layers of metal meshes is related to a mesh number of the metal mesh 300. The number of layers of metal meshes 300 is negatively related with the mesh number of the metal mesh 300, that is, the number of layers of metal meshes with a large mesh number is relatively small, and the number of layers of metal meshes with a small mesh number is relatively large. For example, the number of layers of metal meshes 300 comprises but is not limited to 2-10 layers. In some embodiments, it may be 2 layers, 3 layers, 5 layers, 8 layers or 10 layers. The mesh number of the metal mesh ranges from 20 meshes to 100 meshes. In some embodiments, it may be 20 meshes, 40 meshes, 50 meshes, 60 meshes, 80 meshes or 100 meshes. Considering that too many layers may lead to insufficient airflow supply and the metal mesh with a larger mesh is expensive, an optimal combination of the number of layers and the mesh number for the metal mesh 300, after a test and research, is 50 meshes and 3 layers. In this way, the metal mesh 300 is attached on the top portion 130 of the fire grate body, and at the same time, the open area of the dividing hole 120 is increased, so that the flue gas emission performance of the fire grate 10 on condition of instant combustion is better, and the nitrogen oxides generated can be reduced. At the same time, a flame stabilizing function is realized by using the metal mesh 300 as a main structure of the fire port, thus an adaptability range of a combustion thermal load of a single piece of fire grate 10 can be increased, which can solve the usage problem that a small load of the adaptability range of the combustion thermal load cannot be lowered. The number of segments of the fire grate 10 can be reduced, thus a simple structure, a convenient manufacture, and a low cost can be achieved. The usage requirement of low nitrogen emission for a whole machine can be met.

[0033] In some embodiments, the metal mesh 300 is attached onto the fire grate body 100 at a position corresponding to the dividing hole 120. Here, the metal mesh 300 may be attached to an interior of the fire grate body 100 at a position corresponding to the dividing hole 120, that is, the metal mesh 300 is actually located within the ventilation channel 110. The metal mesh 300 may also be attached to an outer surface of the fire grate body 100 at a position corresponding to the dividing hole 120, that is, the metal mesh 300 is located between a top of the flame stabilizing device 200 and the top portion 130 of the fire grate body 100, and disposed against the top portion 130 of the fire grate body 100. In addition, in an embodiment in which the metal mesh 300 is attached to the interior of the fire grate body 100, an airflow consisted of a mixture of air and combustion gas from the ventilation channel 110 is divided by the metal mesh 300 for a first time, then is fully divided and mixed by the metal mesh 300, and finally, burns above the dividing hole 120 to form a stable and uniform flame. In some embodiments, if the metal mesh 300 is protected better, the metal mesh 300 will be used longer. At the same time, the flame will burn more completely because of the metal mesh 300, and the flame is relatively uniform and stable. In an embodiment in which the metal mesh 300 is attached to an exterior of the fire grate body 100, the airflow consisted of a mixture of air and combustion gas from the ventilation channel 110 is divided by the dividing hole 120 for a first time, then is fully divided and mixed by the metal mesh 300, and finally burns above the metal mesh 300 to form a stable and uniform flame. In some embodiments, a damage to the metal mesh 300 will be greater, but a combustion of the combustion gas is more sufficient than the previous embodiments, and the flame is more uniform and stable. In addition, it should be noted that the dividing hole 120 may divide the flame, or may divide the airflow consisted of a mixture of air and combustion gas, which depends on an installation position of the metal mesh 300.

[0034] In some embodiments, in order to further improve a stability of the flame, the fire grate 10 also comprises a flame stabilizing device 200, and the flame stabilizing device 200 is sleeved on an upper portion of the fire grate body 100. A cavity 210 with a top surface as an opening 211 is formed within the flame stabilizing device 200, and the opening 211 corresponds to the dividing hole 120. Please refer to FIG. 3 and FIG. 18 to FIG. 21 for details. There are at least two schemes for configuring the flame stabilizing device 200 for stabilizing the flame. A first scheme for configuring the flame stabilizing device 200 is to dispose a flame guiding part 240 at the opening 211 of the flame stabilizing device 200. The flame guiding part 240 is disposed in a width direction of the top portion 130 of the fire grate body, and the flame guiding part 240 is formed to extend upward and outwards relative to a horizontal direction. By disposing the flame guiding part 240 in the width direction on two sides of the top portion 130 of the fire grate body, the flame guiding part 240 can play a role in guiding a side flame formed at the dividing hole 120, thus the side flame can be caused to be gathered toward a target area of the fire grate 10, and it is beneficial to improve a heat accumulation effect in a combustion process. A second scheme for configuring the flame stabilizing device 200 is that, by configuring an overall structure of the flame stabilizing device 200, a gap 212 is formed between the side wall of the cavity 210 and the surface of the fire grate body 100, the gap 212 being in communication with the ventilation channel 110. In this way, with a design of the gap 212 in the flame stabilizing device 200 being in communication with the ventilation channel 110, a gas outlet space is increased, and in turn a resistance endured by the air flow can be reduced. It can be understood that, also in order to ensure a safety, the gap 212 should not be too large, and is expected to be between 2 mm and 20 mm. In some embodiments, the gap 212 may be, comprising but not limited to 2 mm, 3 mm, 4 mm, 6 mm, 8 mm, 10 mm, 12 mm, 14 mm, 16 mm, 18 mm, and 20 mm.

[0035] A dividing device of a burner in the related art is usually provided with a plurality of strip-shaped dividing holes of a same shape. On the one hand, due to a small area of a single strip-shaped dividing hole, an overall flow area of the dividing device as a whole is small, resulting in a high pressure of a mixed gas flowing through the dividing device

and an too high combustion intensity of the mixed gas during a combustion process. Thus, a combustion of the mixed gas is incomplete, resulting in a higher content of the nitrogen oxides formed during the combustion process. On the other hand, processing a plurality of strip-shaped dividing holes on the dividing device leads to a relatively complicated structure of the dividing device, thus there are defects of a high processing difficulty and a low processing efficiency.

[0036] In technical solutions of the present invention, the top portion 130 of the fire grates 10 is provided with a fire port structure and a flame stabilizing device 200, the fire port structure being formed by combining the dividing hole 120 with a larger open area and the metal mesh 300. In some embodiments, by increasing the open area of the dividing hole 120, the flue gas emission performance on condition of instant combustion can be better, and the nitrogen oxides generated can be reduced. Furthermore, a dual flame stabilizing effect can be generated by adopting the metal mesh 30 and the flame stabilizing device 2, thus the adaptability range of the combustion thermal load of a single piece of fire grate 10 can be increased. The usage problem that a small load of the adaptability range of the combustion thermal load cannot be lowered can be solved. The number of segments of the fire grate 10 can be reduced, thus a simple structure, a convenient manufacture, and a low cost can be achieved. The usage requirement of low nitrogen emission for a whole machine can be met.

[0037] Please refer to FIG. 5 and FIG. 6. In an embodiment, in order to reduce a difficulty of processing on the premise of ensuring a low-nitrogen combustion, the dividing holes 120 are arranged at intervals along a length direction of the top portion 130 of the fire grate body. In some embodiments, the dividing holes 120 comprise a plurality of first dividing holes 121 and a plurality of second dividing holes 122. The plurality of first dividing holes 121 and the plurality of the second dividing holes 122 are arranged at intervals along the length direction of the top portion 130 of the fire grate body.

[0038] Please refer to FIG. 6 or FIG. 10, on the basis of the previous embodiments, the plurality of first dividing holes 121 and the plurality of the second dividing holes 122 are alternately arranged at intervals along the length direction of the top portion 130 of the fire grate body. In some other embodiments, in order to further increase an area of secondary time contact of the combustion gas with the air, the second dividing holes 122 comprise a plurality of sub-dividing holes 122a. The plurality of sub-dividing holes 122a are arranged along a width direction of the top portion 130 of the fire grate body. The open area of the first dividing holes 121 is larger than the open area of the second dividing holes 122. In this way, by configuring the dividing holes 120 with different open areas, the area of secondary time contact of combustion gas with the air can be increased.

[0039] Please refer to FIG. 3, FIG. 12, and FIG. 15 to FIG. 17. In another embodiment, the metal mesh 300 may be stacked in various ways, for example, in a way of rolling shutter shape or S shape and so on. It is worth mentioning that, in order to increase a strength of the metal mesh 300 and improve a combustion stability of the flame, edges of two opposite sides of each layer of metal mesh are bent to form a bent part 310. A tension will be generated at the bent part 310, and the strength of the metal mesh after being bent is higher. Here, a bent edge may be two sides in the width direction, or may be two sides in the length direction. Considering from a perspective of effect, the bent parts 310 at two ends in the length direction of the metal mesh have a greater tension, and the strength of the metal mesh can also be greater. At the same time, the bent part 310 of each layer of metal mesh is connected to the bent part 310 of another layer or to another layer of metal mesh, and a gap is formed between adjacent two layers of metal mesh. In this way, the resistance endured by the airflow flowing through the metal mesh can be reduced to ensure an adequate airflow.

[0040] Please refer to FIG. 18 to FIG. 21, it is worth mentioning that, in order to strengthen a structure strength of the flame stabilizing device 200, the flame stabilizing device 200 is also provided with reinforcement ribs 220 at the opening 211. The reinforcement ribs 220 are fixedly connected to the metal mesh 300, or the reinforcement ribs 220 are fixedly connected to the top portion 130 of the fire grate body 100. At the same time, in order to improve a combustion rate of the fire grate 10, the flame stabilizing device 200 comprises two side plates disposed to be snapped with each other. The two side plates are respectively provided with lateral convex hulls 230, and the lateral convex hulls 230 are arranged at intervals along the length direction of the flame stabilizing device 200. The lateral convex hull 230 comprise an inner convex hull 232 and at least two external convex hulls 231. The inner convex hull 232 protrudes toward the cavity 210, and the at least two external convex hulls 231 protrude toward an outside of the fire grate 10. The inner convex hull 232 is disposed between the at least two external convex hulls 231.

[0041] For the convenience of description, the two side plates are respectively named as a first side plate and a second side plate for introduction.

[0042] In some embodiments, the first side plate and the second side plate can be snapped with each other, and the plurality of lateral convex hulls 230 are respectively provided along the length direction of the first side plate and the second side plate. The plurality of lateral convex hulls 230 are arranged at intervals along the length direction of the first side plate or the second side plate. The lateral convex hull 230 comprises an inner convex hull 232 and at least two external convex hulls 231. The inner convex hull 232 protrudes toward the cavity 210. A protruding direction of the at least two external convex hulls 231 is opposite to that of the inner convex hull 232. Thus, such design of the inner convex hull 232 and external convex hulls 231 can firstly facilitate a positioning of the flame stabilizing device 200 during mounting, and secondly cause a ventilation channel to be formed between the flame stabilizing device 200 and an outer wall of the cavity 210. The external convex hulls 231 guarantee a secondary air intake channel between the fire grates 10. In

some embodiments, in order to facilitate processing, and to facilitate an arrangement and mounting in a scenario in which multiple fire grates 10 are used at the same time, the convex hull of the first side plate and the lateral convex hull 230 of the second side plate are distributed symmetrically in the width direction of the fire grate body 100.

[0043] In some embodiments, the first side plate and the second side plate are provided with a flame guiding part 240 extending upward. In some embodiments, the flame guiding part 240 can be formed by a top edge of the first side plate and a top edge of the second side plate extending upward and outward along a vertical direction. By disposing the flame guiding part 240 on the top edge of the first side plate and the second side plate, the flame guiding part 240 can play a role in guiding a formation of the flame at the top edge of the side plate, thus the side flame can be caused to be gathered toward a center of a single piece of fire grate 10, facilitating the improvement of the heat accumulation effect in the combustion process.

[0044] Please refer to FIG. 8 to FIG. 17, in another embodiment, the top portion 130 of the fire grate body 100 is plate-shaped, and the fire grate body 100 has two side plates 140 extending from the top portion 130 to the same side of the top portion 130. The ventilation channel 110 is formed between the two side plates. In order to further improve the stability of the flame, the side plate has a gas outlet 150 thereon to communicate the ventilation channel 110 to the gap 212. In some embodiments, by providing the gas outlet 150, the gas outlet space of the mixed gas is increased on both sides, to facilitate a resistance endured by a mixed air flow to be reduced, thus mixed air flow can be enabled to stay above the fire grate 10 for a slightly longer time, and thus the combustion rate of the combustion gas is further improved and a content of nitrogen after gas combustion is further reduced.

[0045] In some embodiments, in order to further reduce the resistance endured by the mixed airflow, there are a plurality of the gas outlets 150. At the same time, in order to further reduce the difficulty of processing, a plurality of the gas outlets 150 are arranged at intervals on the side plate along the length direction of the top portion 130 of the fire grate body. In some embodiments, please refer to FIG. 17, a flow passing area of the gas outlet 150 gradually increases from the ventilation channel 110 to the gap 212. That is to say, the gas outlet 150 is designed in a trumpet shape. In some embodiments, a portion on which the gas outlet 150 is located protrudes toward the ventilation channel 110 to further reduce the resistance endured by the mixed airflow.

[0046] The present invention also provides a method for manufacturing the fire grate 10, that is, how to manufacture the aforementioned fire grate 10. In some embodiments, the method for manufacturing the fire grate 10 comprises the following steps that:

[0047] In S10, a metal plate, a metal mesh and a flame stabilizing sheet 201 are prepared;

[0048] In S20, the metal plate is shaped to form a fire grate body 100 with a ventilation channel 110 and a dividing hole 120, the dividing hole 120 being located at a top portion 130 of the fire grate body 100 and being in communication with the ventilation channel 110;

[0049] In S30, the flame stabilizing sheet 201 is shaped to form a flame stabilizing device 200 which has a cavity 210 with a top surface as an opening 211;

[0050] In S40, the metal mesh 300 is fixed onto the fire grate body 100 at a position corresponding to the dividing hole 120; or the metal mesh 300 is fixed onto the flame stabilizing device 200 at a position corresponding to the dividing hole 120; and

[0051] In S50, the flame stabilizing device 200 is sleeved on an upper portion of the fire grate body 100.

[0052] In some embodiments, the metal plate is shaped to form the fire grate body 100 with the ventilation channel 110 and the dividing hole 120, and the metal plate is a relatively thin metal plate which needs to have certain properties of rigidity and high temperature resistance. Then the metal plate is shaped according to a preset shape, to cause the metal plate to form a preliminary shape of the fire grate body 100. Finally other three sides of the metal plate are cut, and then other three sides of the metal plate are snapped with one another to form the fire grate body 100 which has the ventilation channel 110 and the dividing hole 120. Here, it should be noted that, the metal mesh 300 may be attached to an interior of the fire grate body 100 at a position corresponding to the dividing hole 120, that is, the metal mesh 300 is actually located within the ventilation channel 110. The metal mesh 300 may also be attached to an outer surface of the fire grate body 100 at a position corresponding to the dividing hole 120, that is, the metal mesh 300 is located between a top portion of the flame stabilizing device 200 and the top portion 130 of the fire grate body 100, and disposed against the top portion 130 of the fire grate body 100.

[0053] In an embodiment in which the metal mesh 300 is attached to the interior of the fire grate body 100, before other three sides of the metal plate are snapped to one another to form the fire grate body 100 which has the ventilation channel 110 and the dividing hole 120, the metal mesh 300 needs to be fixed firstly onto the fire grate body 100 at a position corresponding to the dividing hole 120. In an embodiment in which the metal mesh 300 is attached to the exterior of the fire grate body 100, the metal mesh 300 may be directly fixed onto the fire grate body 100 at a position corresponding to the dividing hole 120, or the metal mesh 300 may be directly fixed onto the flame stabilizing device 200, or the metal mesh 300 may be temporarily pre-mounted onto the flame stabilizing device 200 or the fire grate body 100. After the flame stabilizing device 200 is sleeved onto the upper portion of the fire grate body 100, the metal mesh 300 is fixed to the fire grate body 100 or the flame stabilizing device 200. That is to say, it is only necessary to ensure that the metal

mesh 300 is attached onto the fire grate body 100 at a position corresponding to the dividing hole 120.

[0054] In some embodiments, a flame stabilizing sheet 201 may also be similar to the above-mentioned thin metal plate. One of the manufacturing methods of the flame stabilizing device 200 is to shape two original flame stabilizing sheets 201, then to wrap the upper portion of the fire grate body 100 from both sides of the fire grate body 100, and finally to snap the two flame stabilizing sheets together. In other embodiments, the flame stabilizing sheet 201 can also be a piece of metal plate. The piece of metal plate is shaped according to a preset shape by stamping, bending and other processes to form an initial shape of the flame stabilizing device 200 which has a cavity 210 with a top surface as an opening 211, and then the flame stabilizing device 200 is sleeved onto the top portion 130 of the fire grate body 100, followed by snapping two ends of the one piece of metal plate to each other. It is worth mentioning that, in other embodiments, the flame stabilizing device 200 is provided with a reinforcement rib 220 at the opening 210. The reinforcement rib 220 is usually fixedly connected to the metal mesh 300, or the reinforcement rib 220 is usually directly connected to the top portion 130 of the fire grate body 100.

[0055] It should be noted that the above-mentioned metal plates are generally thin iron plates. A way of fixing the above-mentioned metal mesh 300 and the fire grate body 100, and a way of fixing the metal mesh 300 and the flame stabilizing device 200 comprise but are not limited to welding, which will not be described in details here. In some embodiments, in various ways of welding, a spot welding is preferred.

[0056] Compared with a traditional manufacturing method, the manufacturing method of the present invention only needs processes such as stamping, bending and cutting, thus a reduced number of welding process ways are used; a machining process is simplified; and machining steps are reduced thereby improving a production efficiency of the fire grate 10.

[0057] In some embodiments, a step that the metal plate is shaped to form a fire grate body 100 with a ventilation channel 110 and a dividing hole 120, the dividing hole 120 being located at a top portion 130 of the fire grate body 100 and being in communication with the ventilation channel 110, may comprise:

[0058] S21, two ends of the metal plate are bent to a same side of the metal plate to form the top portion 130 of the fire grate body 100 and the two side plates 140 extending from the top portion 130 to the same side of the top portion 130; before the metal plate is bent, the dividing hole 120 is punched out at a position corresponding to the top portion 130, or after the metal plate is bent, the dividing hole 120 is punched out at the top portion 130; and

[0059] S22, the two side plates are stamped to form the ventilation channel 110 between the two side plates 140.

[0060] S21 may contain two options.

[0061] Option one:

S21a, two ends of the metal plate are bent to a same side of the metal plate to form the top portion 130 of the fire grate body 100 and the two side plates 140 extending from the top portion 130 to the same side of the top portion 130; and

S21b, the dividing hole 120 is punched out on the top portion 130 after the metal plate is bent.

[0062] Option two:

S21c, the dividing hole 120 is punched out at a position corresponding to the top portion 130 before the metal plate is bent; and

S21a, two ends of the metal plate are bent to a same side of the metal plate to form the top portion 130 of the fire grate body 100 and the two side plates 140 extending from the top portion 130 to the same side of the top portion 130.

[0063] In some embodiments, in the step that the metal plate is shaped to form a fire grate body 100 with a ventilation channel 110 and a dividing hole 120, the dividing hole 120 may be firstly punched out at a predetermined position, or a position of the dividing hole 120 may be reserved first. With a reserved part as a central axis, the two ends of the metal plate are bent to a same side of the metal plate to form the top portion 130 of the fire grate body 100 and the two side plates 140 extending from the top portion 130 to the same side of the top portion 130. Then, the two side plates are stamped according to a preset shape and position of the ventilation channel 110, to cause the two side plates 140 after being snapped to form the ventilation channel 110.

[0064] In some embodiments, the step that the two side plates are stamped to form the ventilation channel 110 between the two side plates 140 comprises that:

corresponding positions of the two side plates are stamped according to a preset shape of the ventilation channel 110; and

the two side plates 140 are snapped with each other after edges of other three sides of the two side plates are cut, and an edge of one of the two side plates 140 after snapped is caused to be wrapped with an edge of the other side plate.

[0065] In some embodiments, after the two side plates are stamped according to a preset shape and position of the ventilation channel 110, the edges of other three sides of the two side plates are cut, to cause an edge of one of the two side plates 140 to be wrapped with an edge of the other side plate, thus a tight fit between the edges of two side plates is strengthened, and in turn an airtightness of the ventilation channel 110 is ensured.

[0066] In an embodiment, before the step that the two side plates are stamped to form the ventilation channel 110 between the two side plates 140, the following steps are further comprised that:
a gas outlet 150 is formed at a preset position of the two side plates, to cause the ventilation channel 110 to be in communication with the gap 212 after the flame stabilizing device 200 is sleeved on the upper portion of the fire grate body 100.

[0067] The present invention also proposes a burner. The burner comprises the aforementioned fire grate 10. A specific structure of the fire grate 10 refers to the above-mentioned embodiments. Since this burner adopts all technical solutions of all the above-mentioned embodiments, it has at least all the above-mentioned beneficial effects brought by the technical solutions of the embodiments, which will not be repeated here. In some embodiments, the burner may be other types of burners such as an atmospheric burner, a rich-lean burner, or a water-cooled burner.

[0068] In an embodiment, as shown in FIG. 7, there may be multiple fire grates 10 which are disposed side by side. The fire grate 10 may comprise two side plates that are snapped with each other. The two side plates are respectively provided with a lateral convex hull 230. The lateral convex hull 230 is disposed adjacent to a top of the side plate, thus flame stabilizing holes are formed by the opening 211 and the lateral convex hull 230.

[0069] In an embodiment, the first side plate and the second side plate are respectively provided with a plurality of lateral convex hulls 230 adjacent to an edge of the top. The plurality of lateral convex hulls 230 are arranged at intervals along the length direction of the first side plate or the second side plate. A flow channel being in communication with the ventilation channel 110 is defined by an inner side of the lateral convex hull 230, and the flame stabilizing holes are formed within the flow channel by the opening 211 and the lateral convex hull 230. Two rows of flame stabilizing holes on the first side plate and the second side plate are respectively located on both sides of the fire grate body 100, and the two rows of flame stabilizing holes are symmetrically distributed in the width direction of the fire grate 10. During the combustion process, the side flames formed at the two rows of flame stabilizing holes on both sides of flame dividing device, can play a stabilizing role on the flame formed above the flame distribution device, thus a flame stability during the combustion process of the burner can be further improved.

[0070] In an embodiment, the flame guiding part 240 may be formed by a top edge of the lateral convex hull 230 extending upward and outwards relative to a horizontal direction. By arranging the flame guiding part 240 on the lateral convex hull 230, the flame guiding part 240 can play a role in guiding a side flame formed at the flame stabilizing hole, to cause the side flame to be gathered toward a central area of the fire grate 10, facilitating the improvement of the heat accumulation effect in the combustion process.

[0071] The present invention also proposes a water heater, which comprises the aforementioned burner. The burner comprises the aforementioned fire grate. A specific structure of the fire grate refers to the above-mentioned embodiments. Since this burner adopts all technical solutions of all the above-mentioned embodiments, it has at least all the above-mentioned beneficial effects brought by the technical solutions of the embodiments, which will not be repeated here.

[0072] The above is only some embodiments of the present invention, and does not therefore limit the scope of protection sought for by the present invention. Under the inventive concept of the present invention, any equivalent structural transformation made by using the description of the present invention and the contents of the accompanying drawings, or any direct/indirect application in other related technical fields is comprised in the scope of protection sought for by the present invention.

Claims

1. A fire grate (10), comprising:

a fire grate body (100), formed with a ventilation channel (110), wherein a top portion of the fire grate body (130) is provided with a dividing hole (120) being in communication with the ventilation channel (110);
a flame stabilizing device (200), sleeved on an upper portion of the fire grate body (130), wherein a cavity (210) with a top surface as an opening (211) is formed within the flame stabilizing device (200), a gap (212) being formed between a side wall of the cavity (210) and a surface of the fire grate body (100), and the gap (212) being in communication with the ventilation channel (110); and
a metal mesh (300), attached onto the fire grate body (100) at a position corresponding to the dividing hole (120);
wherein the flame stabilizing device (200) is also provided with a reinforcement rib (220) at the opening (211), the reinforcement rib (220) being fixedly connected to the metal mesh (300).

2. The fire grate (10) according to claim 1, wherein there are multiple layers of metal meshes (300).

3. The fire grate (10) according to claim 2, wherein the metal mesh (300) is located below the dividing hole (120); or wherein an edge of at least one layer of the metal meshes (300) is bent to form a bent part (310).

4. The fire grate (10) according to claim 2, wherein the dividing hole (120) comprises a plurality of first dividing holes (121) and a plurality of second dividing holes (122), an open area of the first dividing holes (121) being larger than an open area of the second dividing holes (122).

5. The fire grate (10) according to claim 4, wherein the plurality of first dividing holes (121) and the plurality of second dividing holes (122) are arranged at an interval along a length direction of the top portion of the fire grate body (130).

6. The fire grate (10) according to claim 5, wherein the plurality of first dividing holes (121) and the plurality of second dividing holes (122) are alternately arranged at an interval along the length direction of the top portion of the fire grate body (130); wherein the second dividing hole (122) preferably comprises a plurality of sub-dividing holes (122a) arranged along a width direction of the top portion of the fire grate body (130).

7. The fire grate (10) according to any one of claims 1 to 6, wherein the top portion of the fire grate body (130) is plate-shaped, and wherein the fire grate body (100) has two side plates (140) extending from the top portion to a same side of the top portion, and wherein the ventilation channel (110) is formed between the two side plates (140), and wherein the side plate (140) has a gas outlet (150) thereon to communicate the ventilation channel (110) to the gap (212).

8. The fire grate (10) according to claim 7, wherein there are a plurality of gas outlets (150), the plurality of the gas outlets (150) being arranged at an interval on the side plate (140) along the length direction of the top portion of the fire grate body (130); or wherein a flow passing area at the gas outlet (150) gradually increases from the ventilation channel (110) to the gap (212).

9. The fire grate according to claim 7, wherein the flame stabilizing device (200) comprises two flame stabilizing sheets (201) snapped with each other, and wherein the two flame stabilizing sheets (201) are respectively disposed with lateral convex hulls (230) arranged at an interval along the length direction of the flame stabilizing device (200).

10. The fire grate (10) according to claim 9, wherein the lateral convex hull (230) comprises an inner convex hull and at least two external convex hulls (231), the inner convex hull protruding toward the cavity (210), the at least two external convex hulls (231) protruding toward an outside of the fire grate (10), the inner convex hull being arranged between the at least two external convex hulls (231).

11. A manufacturing method for a fire grate (10), comprising the following steps:

(S10) preparing a metal plate, a metal mesh (300) and a flame stabilizing sheet (201);
(S20) shaping the metal plate to form a fire grate body (100) with a ventilation channel (110) and a dividing hole (120), the dividing hole (120) being located at a top portion of the fire grate body (130) and in communication with the ventilation channel (110);
(S30) shaping the flame stabilizing sheet (201) to form a flame stabilizing device (200) which has a cavity (210) with a top surface as an opening (211);
(S40) fixing the metal mesh (300) onto the fire grate body (100) at a position corresponding to the dividing hole (120); or fixing the metal mesh (300) onto the flame stabilizing device (200) at a position corresponding to the dividing hole (120); and
(S50) sleeving the flame stabilizing device (200) on an upper portion of the fire grate body (130).

12. The manufacturing method of a fire grate according to claim 11, wherein, the step of (S20) shaping the metal plate to form a fire grate body (100) with a ventilation channel (110) and a dividing hole (120), the dividing hole (120) being located at a top portion of the fire grate body (130) and in communication with the ventilation channel (110) comprises:

(S21a) bending two ends of the metal plate to a same side of the metal plate to form the top portion of the fire grate body (130) and the two side plates (140) which extend from the top portion to the same side of the top portion, wherein (S21c) before the plate is bent, the dividing hole (120) is punched out at a position corresponding

to the top portion, or (S21b) after the metal plate is bent, the dividing hole (120) is punched out at the top portion; and

(S22) stamping the two side plates (140) to form the ventilation channel (110) between the two side plates (140); wherein the step of (S22) stamping the two side plates (140) to form the ventilation channel (110) between the two side plates (140) preferably comprises:

(S221) stamping corresponding positions of the two side plates (140) according to a preset shape of the ventilation channel (110); and

(S222) snapping the two side plates (140) after edges of other three sides of the two side plates (140) are cut, and causing an edge of one side plate (140) of the two side plates (140) to be wrapped with an edge of the other side plate (140) after snapping.

13. A burner, comprising a fire grate (10) according to any one of claims 1 to 10.

14. The burner according to claim 13, wherein there are a plurality of fire grates (10) arranged side by side.

15. A water heater, comprising a burner according to claim 13 or 14.

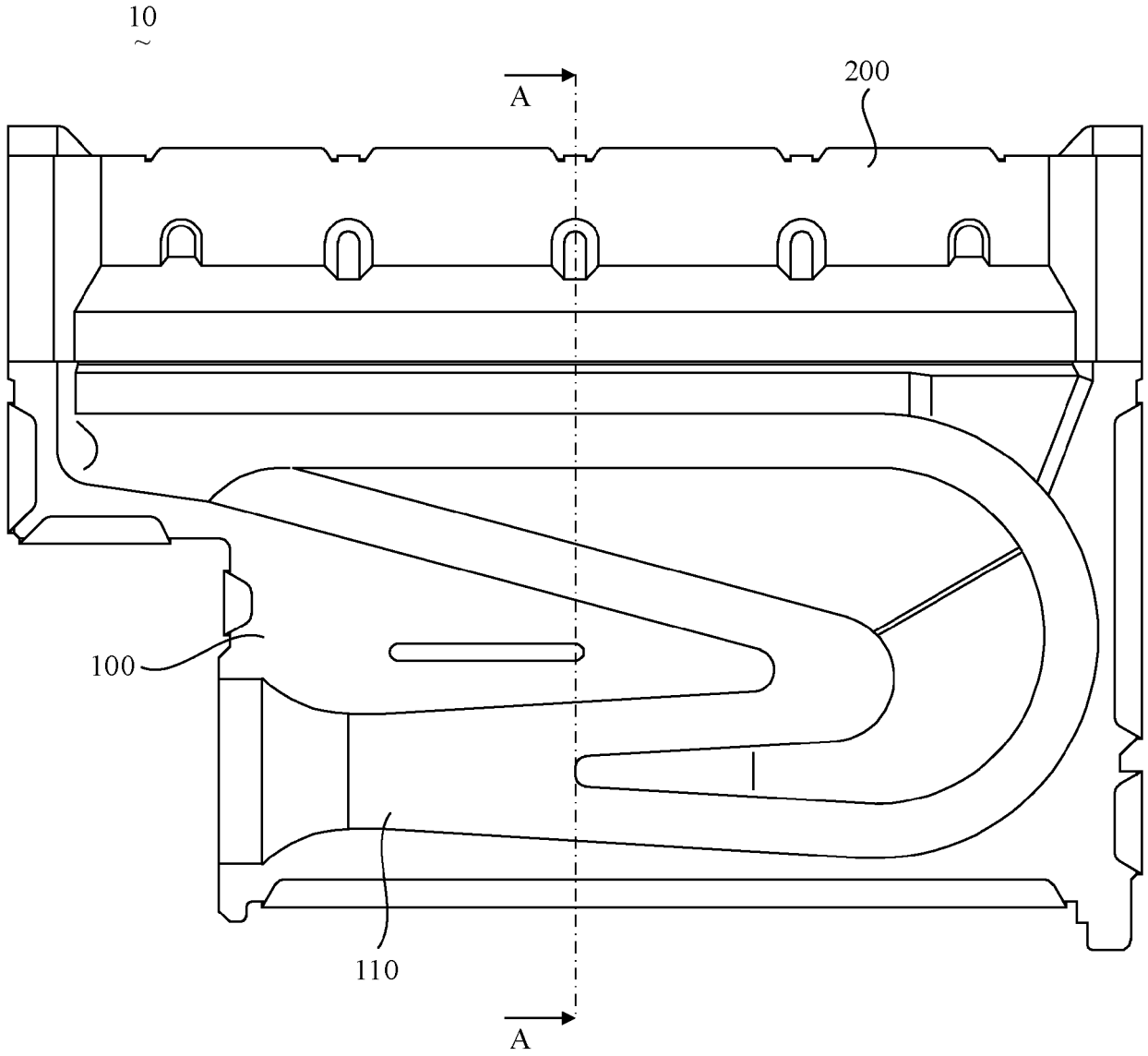

FIG. 1

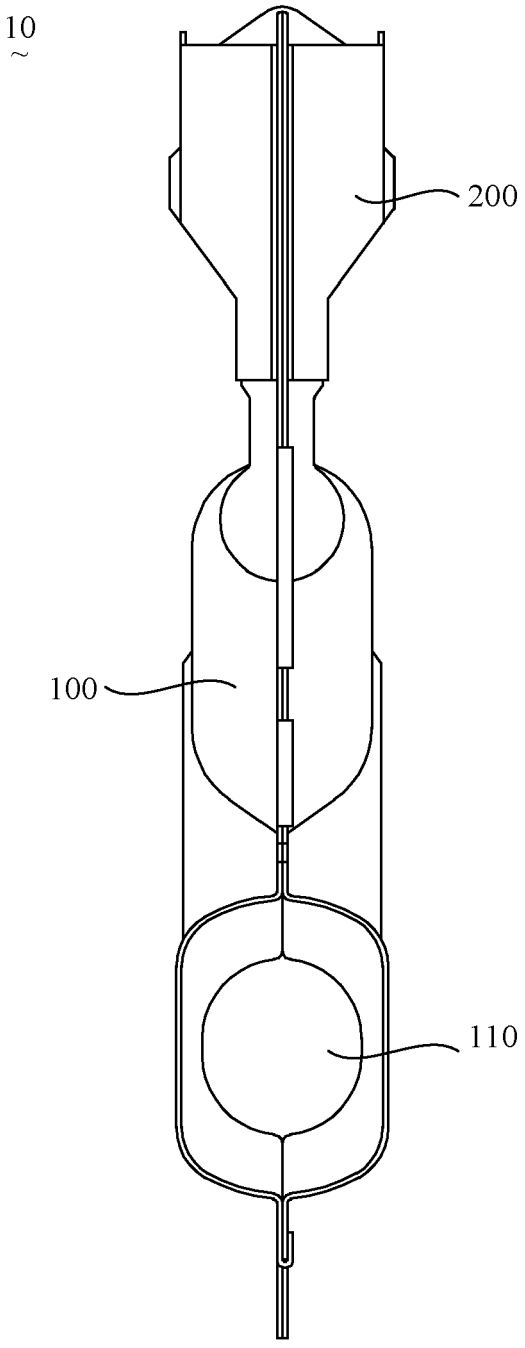

FIG. 2

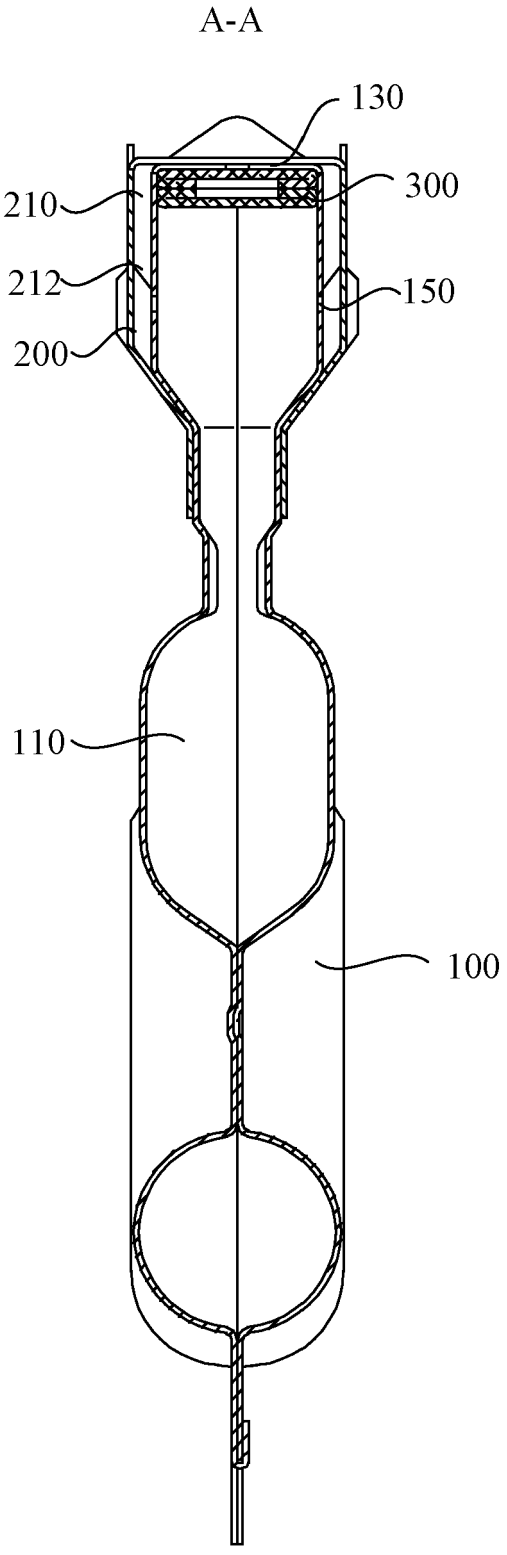

FIG. 3

A-A

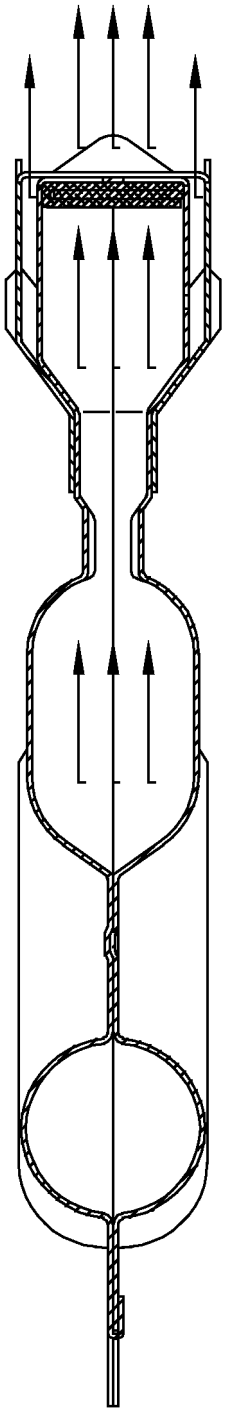

FIG. 4

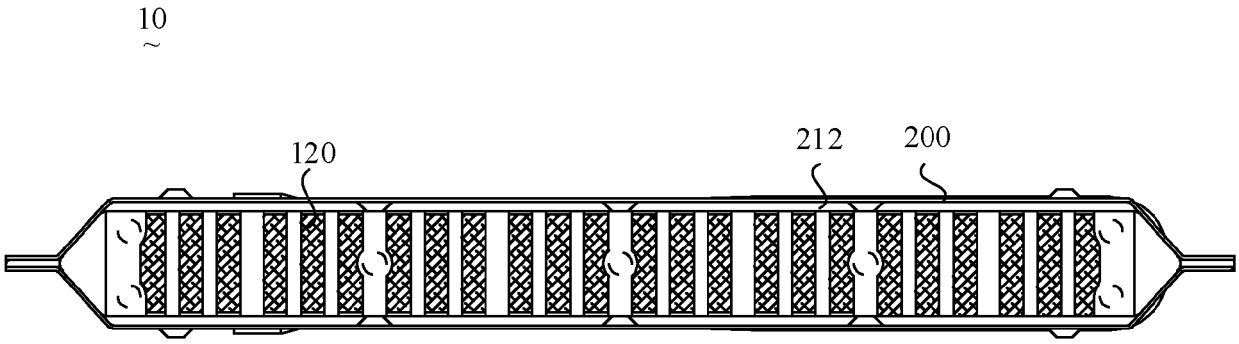

FIG. 5

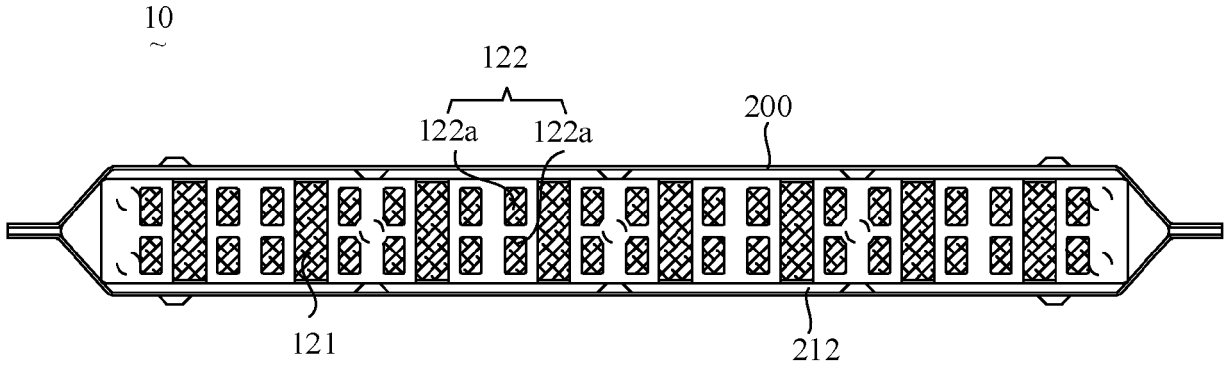

FIG. 6

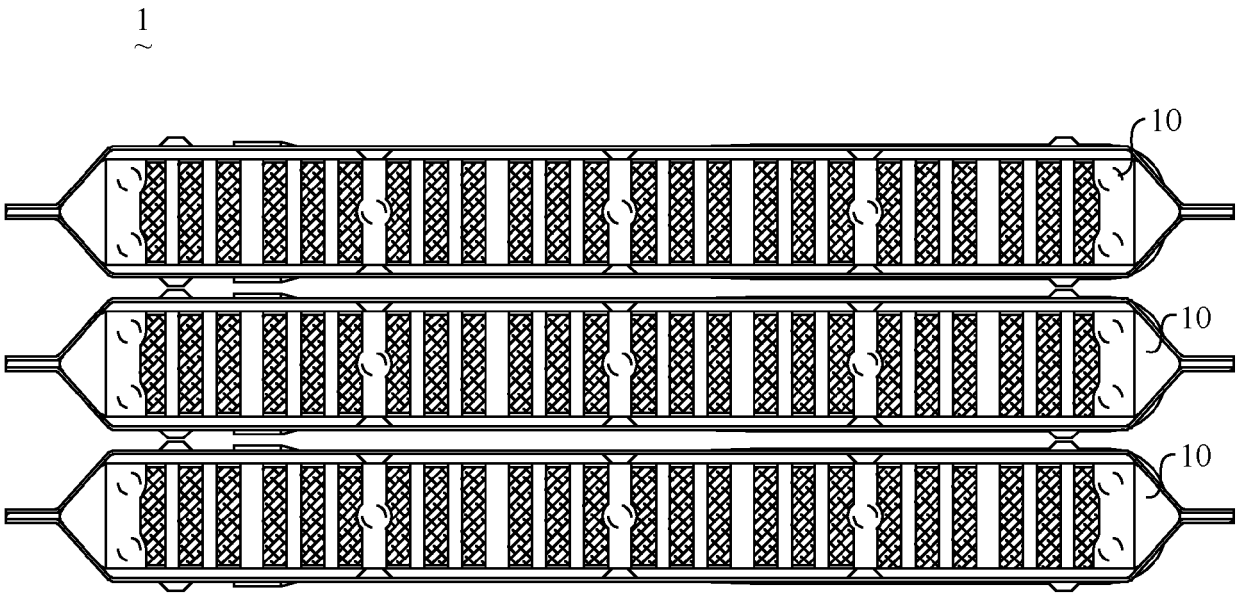

FIG. 7

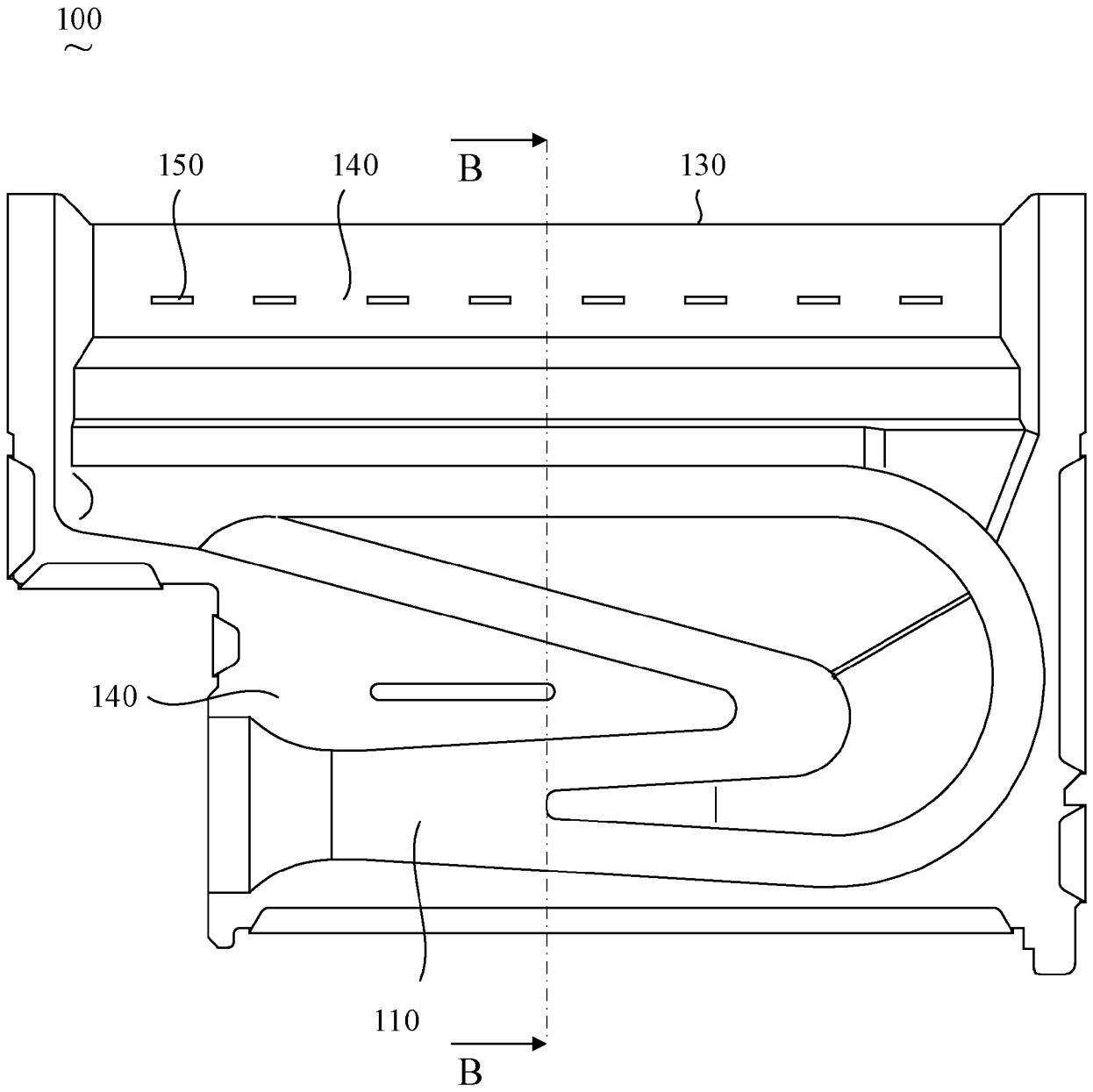

FIG. 8

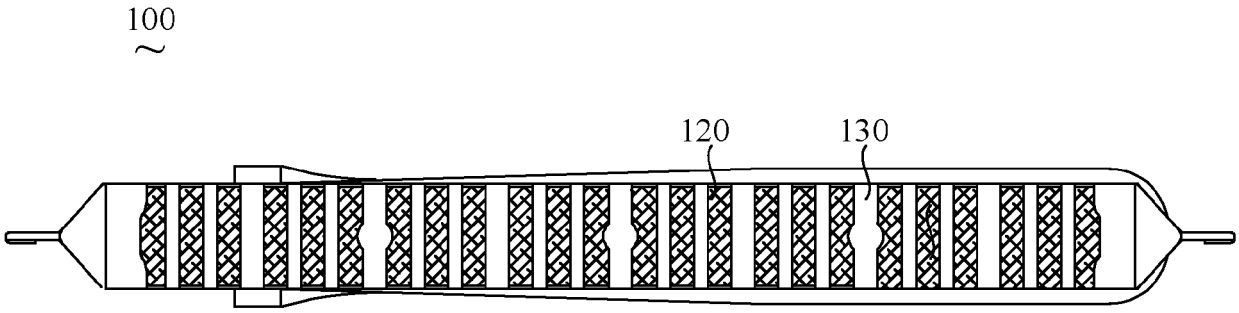

FIG. 9

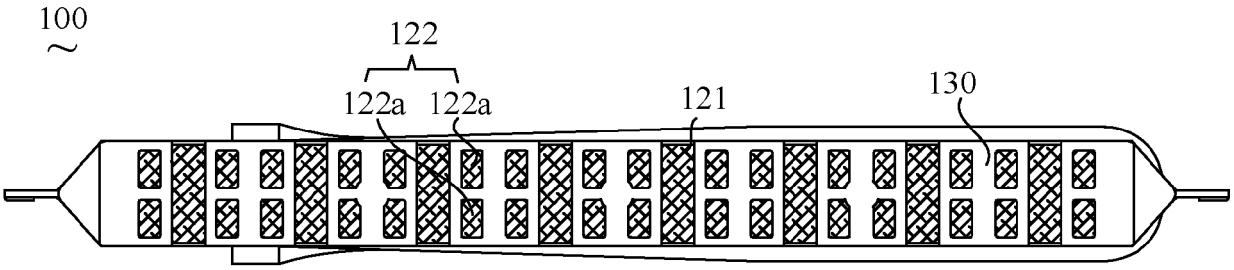

FIG. 10

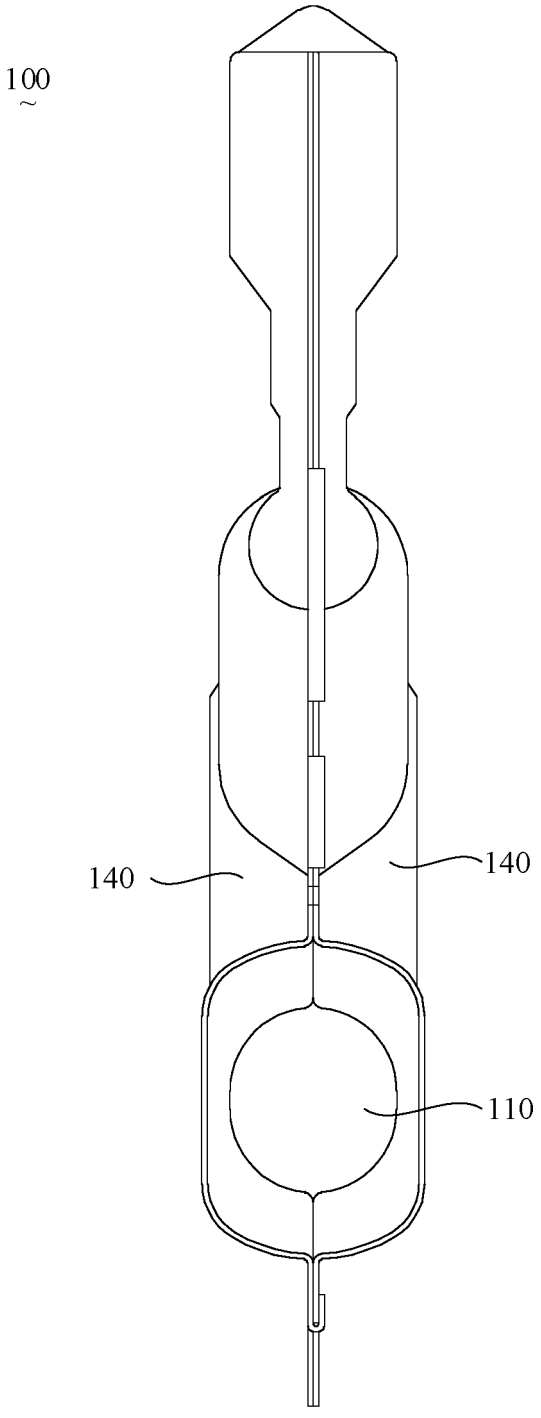

FIG. 11

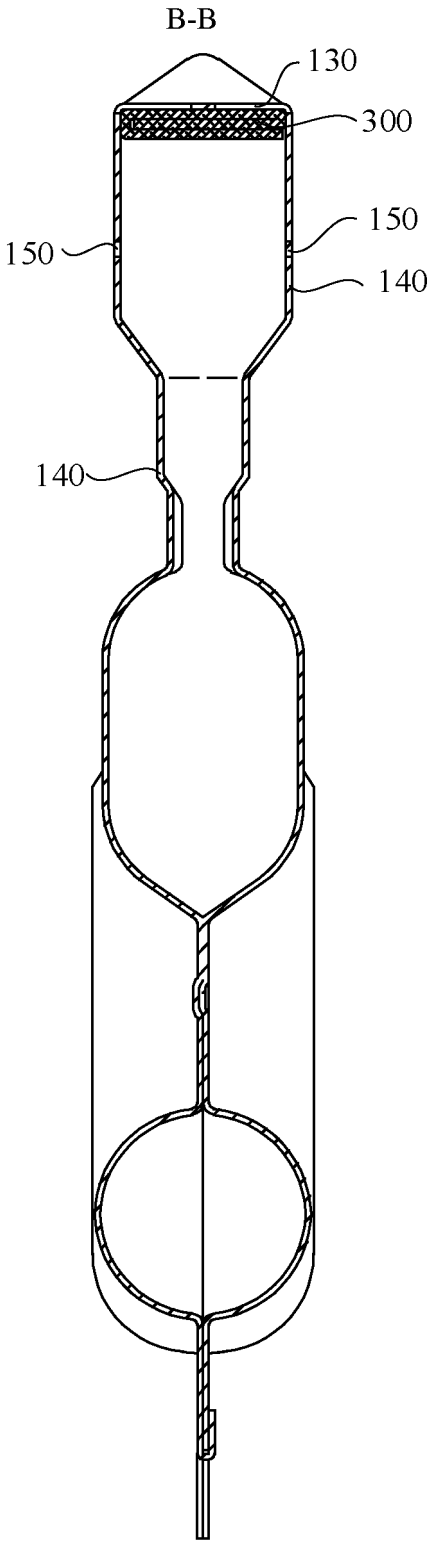

FIG. 12

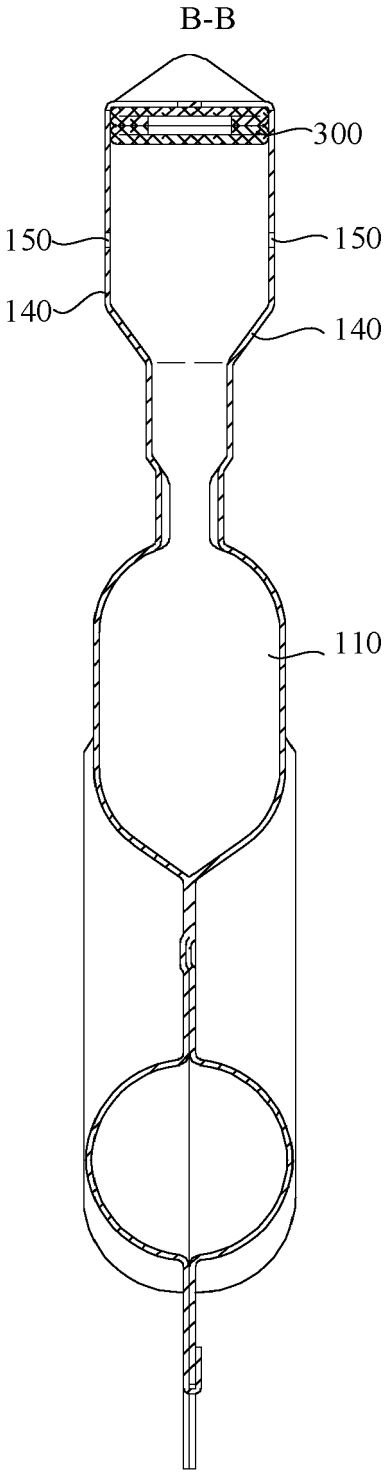

FIG. 13

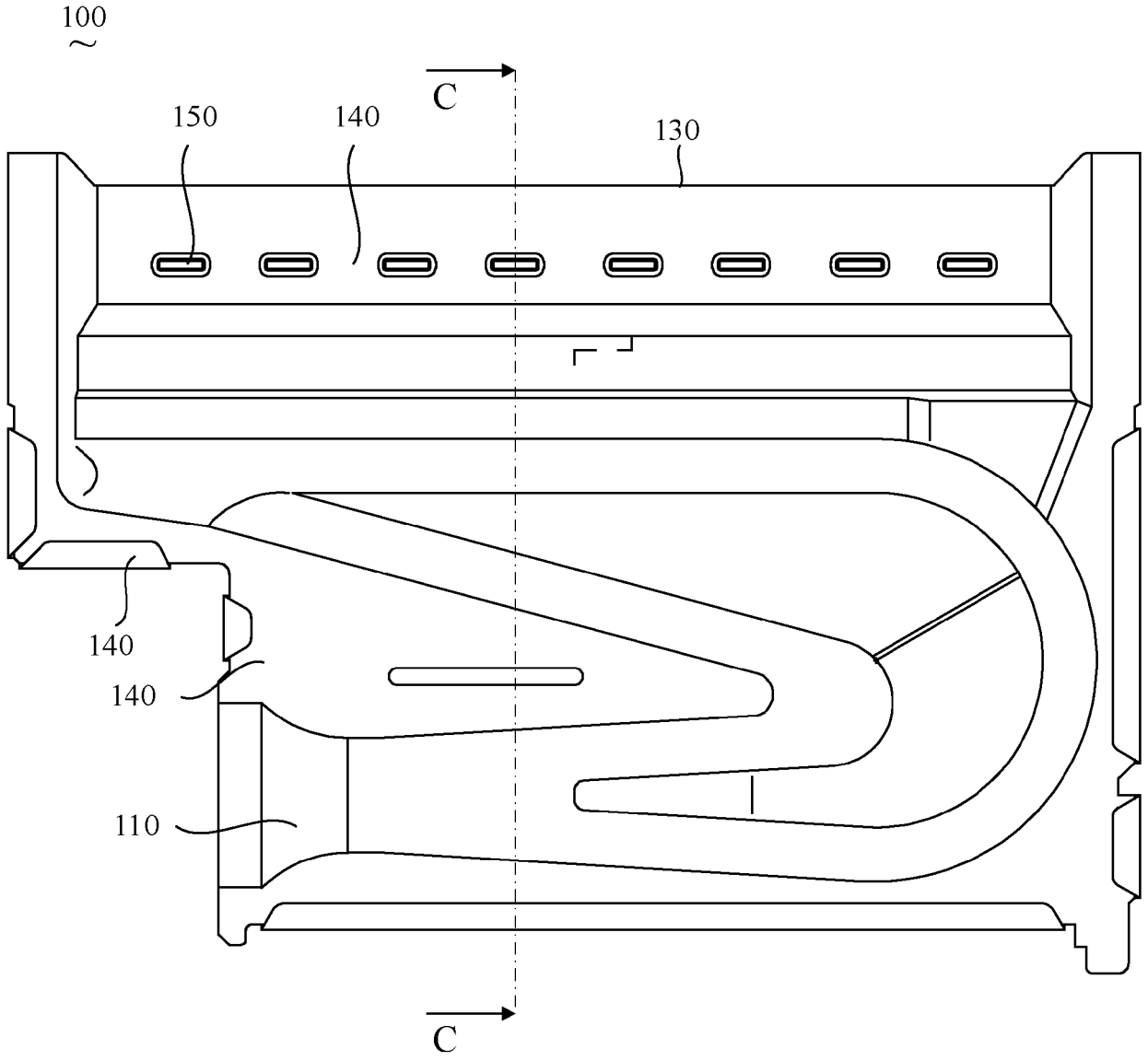

FIG. 14

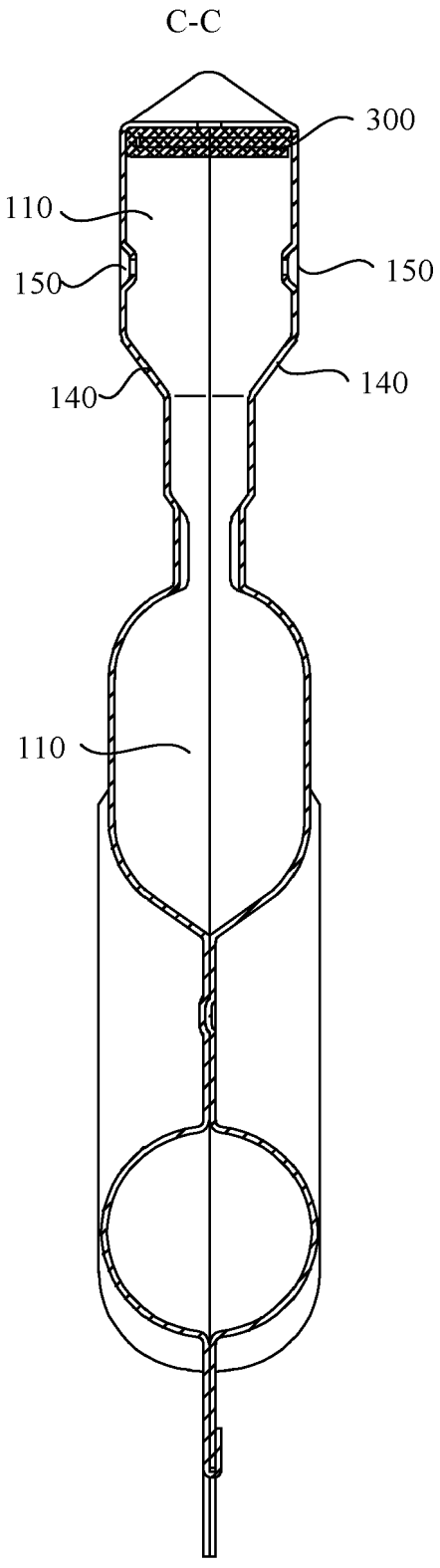

FIG. 15

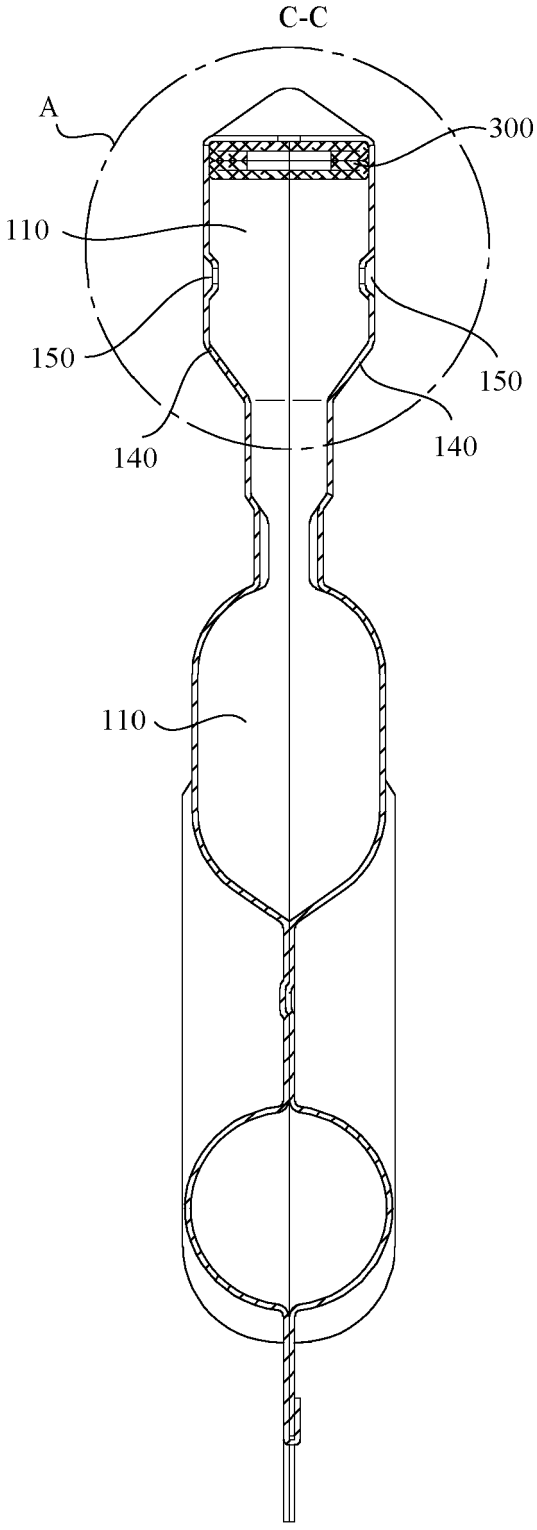

FIG. 16

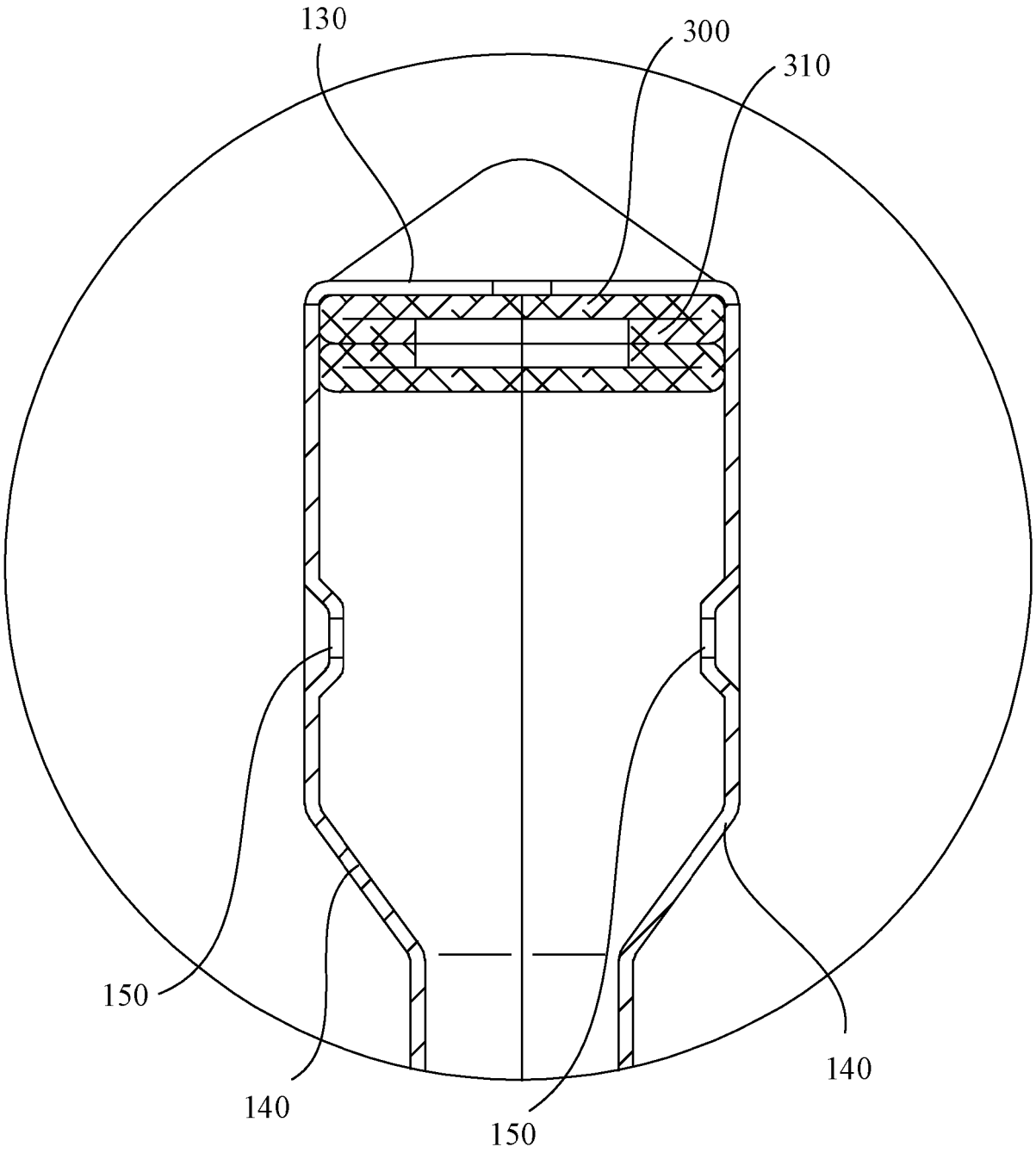

FIG. 17

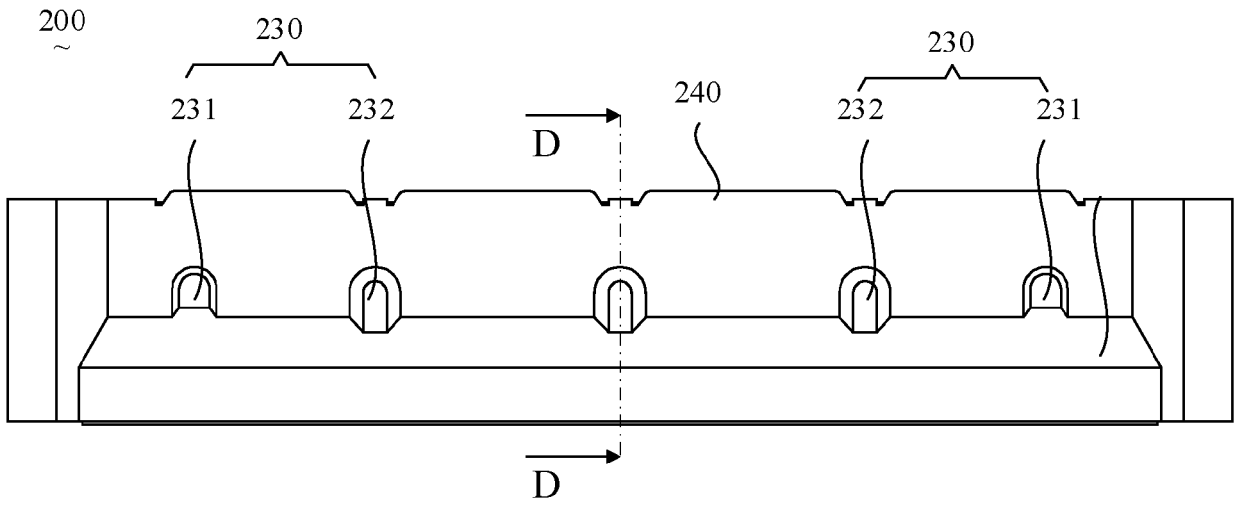
200
230
231
232
240
D
230
232
231
D

FIG. 18

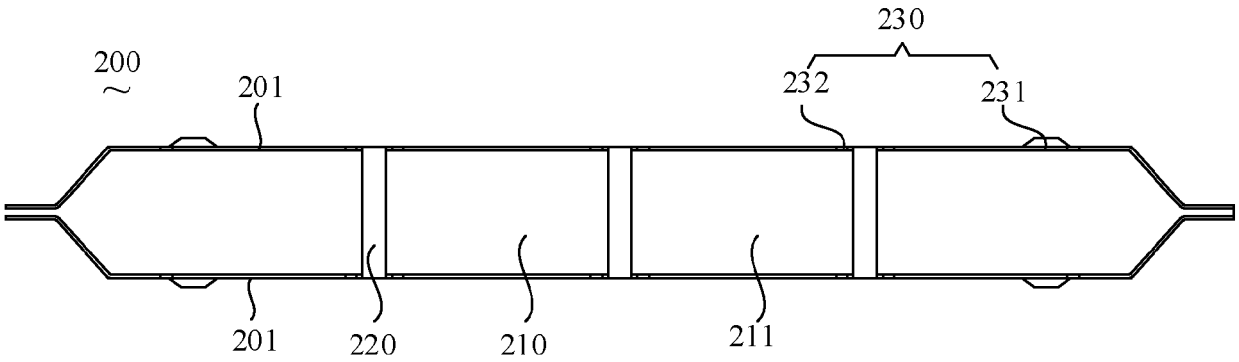
200
201
230
232
231
201
220
210
211

FIG. 19

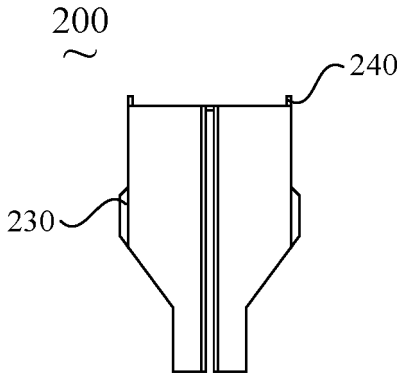

FIG. 20

D-D

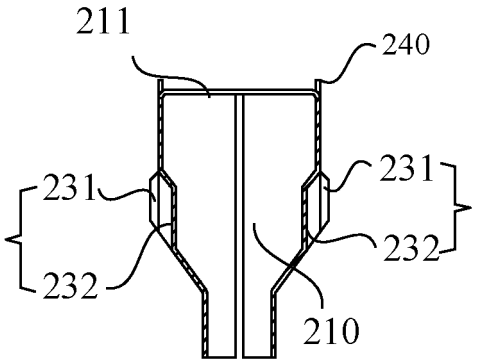

FIG. 21

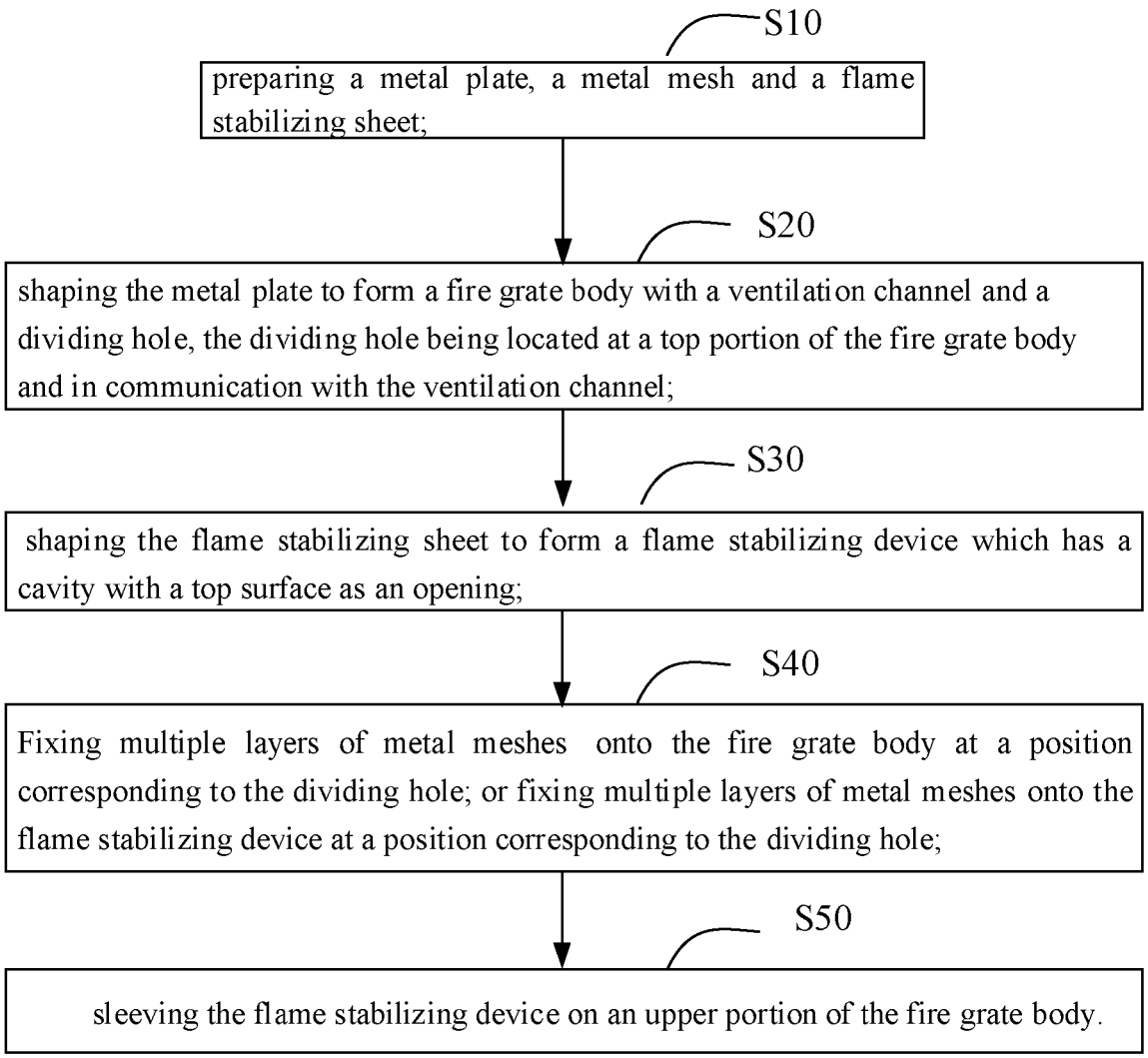
S10
preparing a metal plate, a metal mesh and a flame stabilizing sheet;
S20
shaping the metal plate to form a fire grate body with a ventilation channel and a dividing hole, the dividing hole being located at a top portion of the fire grate body and in communication with the ventilation channel;
S30
shaping the flame stabilizing sheet to form a flame stabilizing device which has a cavity with a top surface as an opening;
S40
Fixing multiple layers of metal meshes onto the fire grate body at a position corresponding to the dividing hole; or fixing multiple layers of metal meshes onto the flame stabilizing device at a position corresponding to the dividing hole;
S50
sleeving the flame stabilizing device on an upper portion of the fire grate body.

FIG. 22

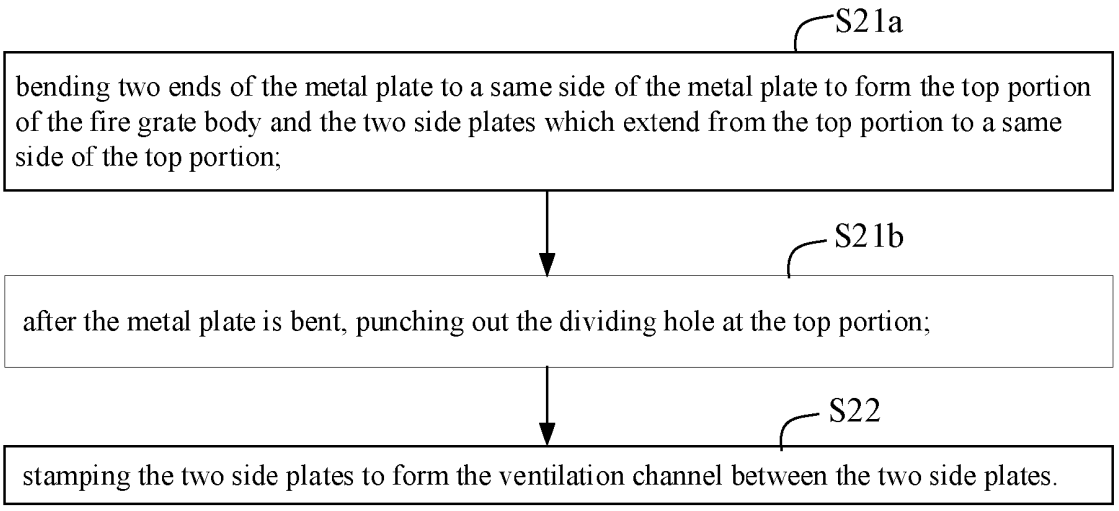

FIG. 23

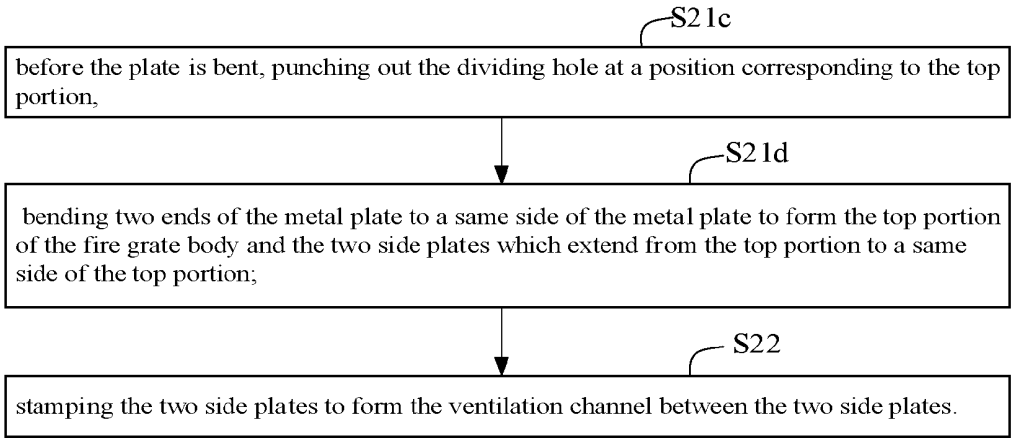

FIG. 24

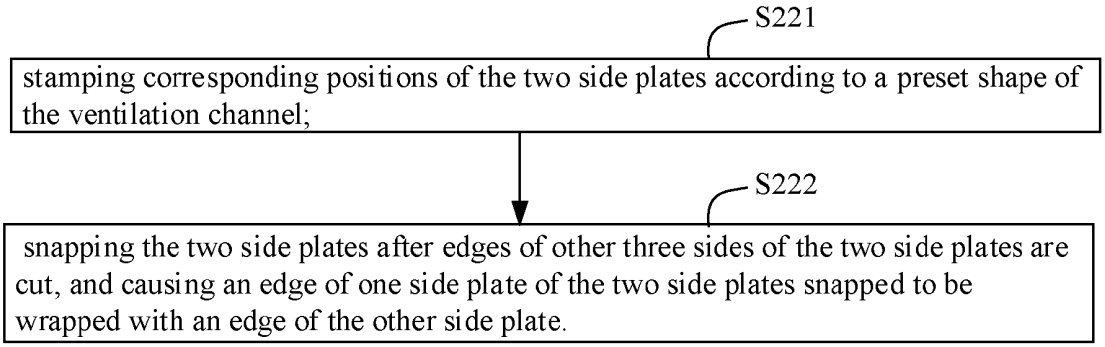

FIG. 25

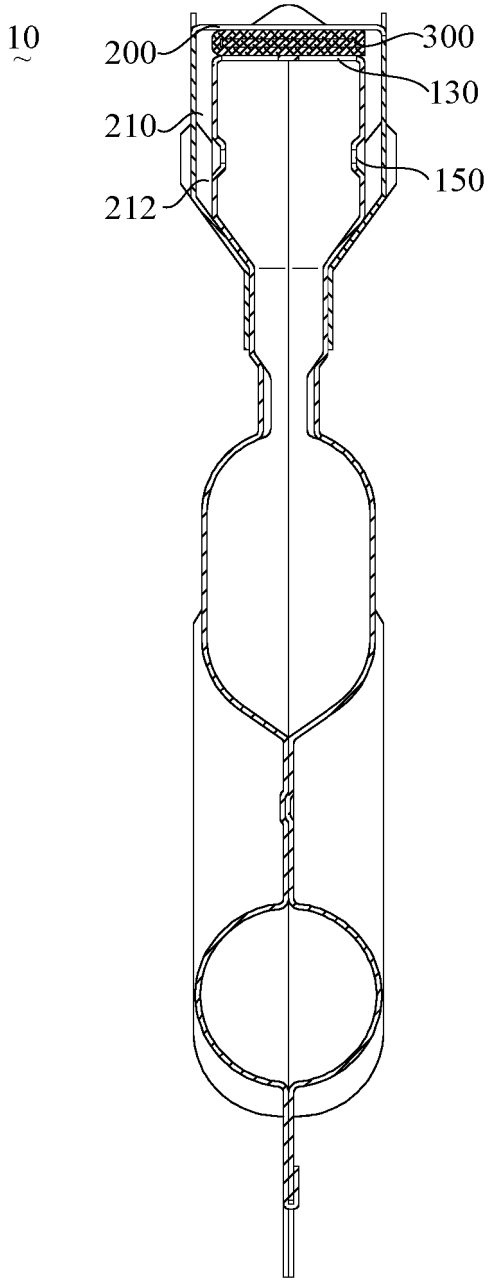

FIG. 26

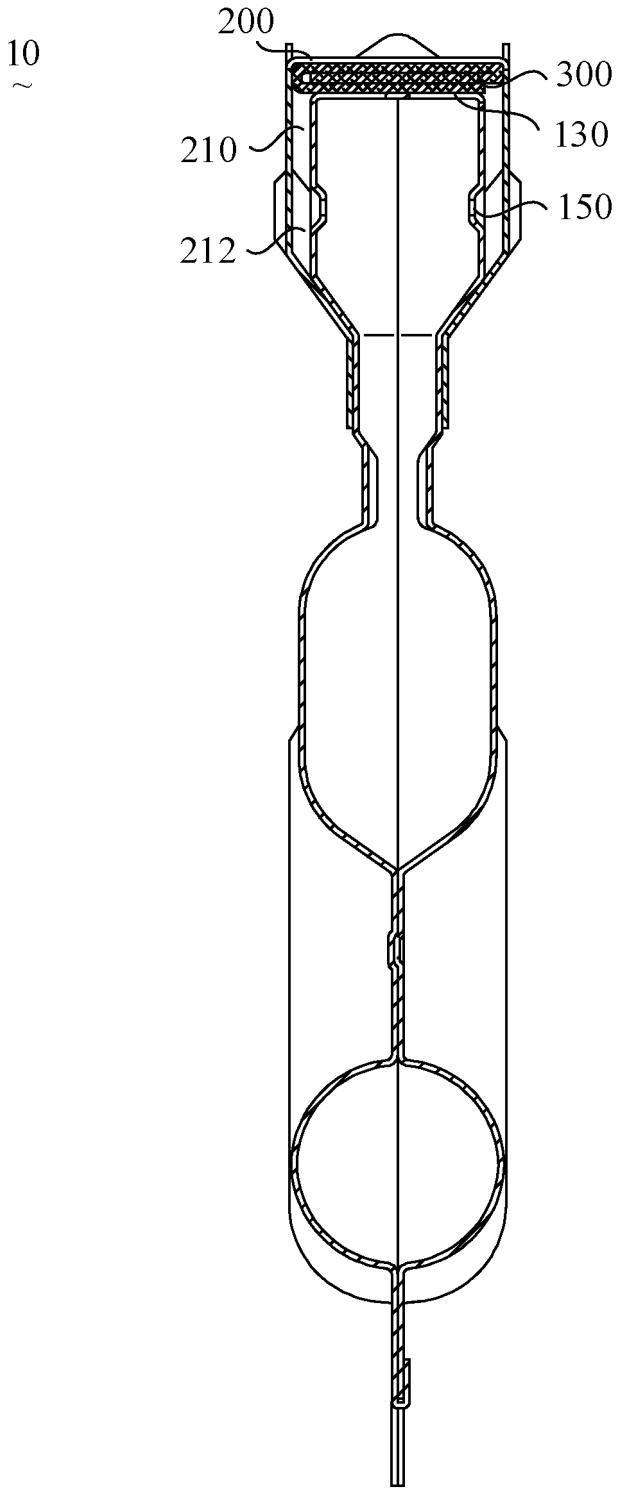

FIG. 27

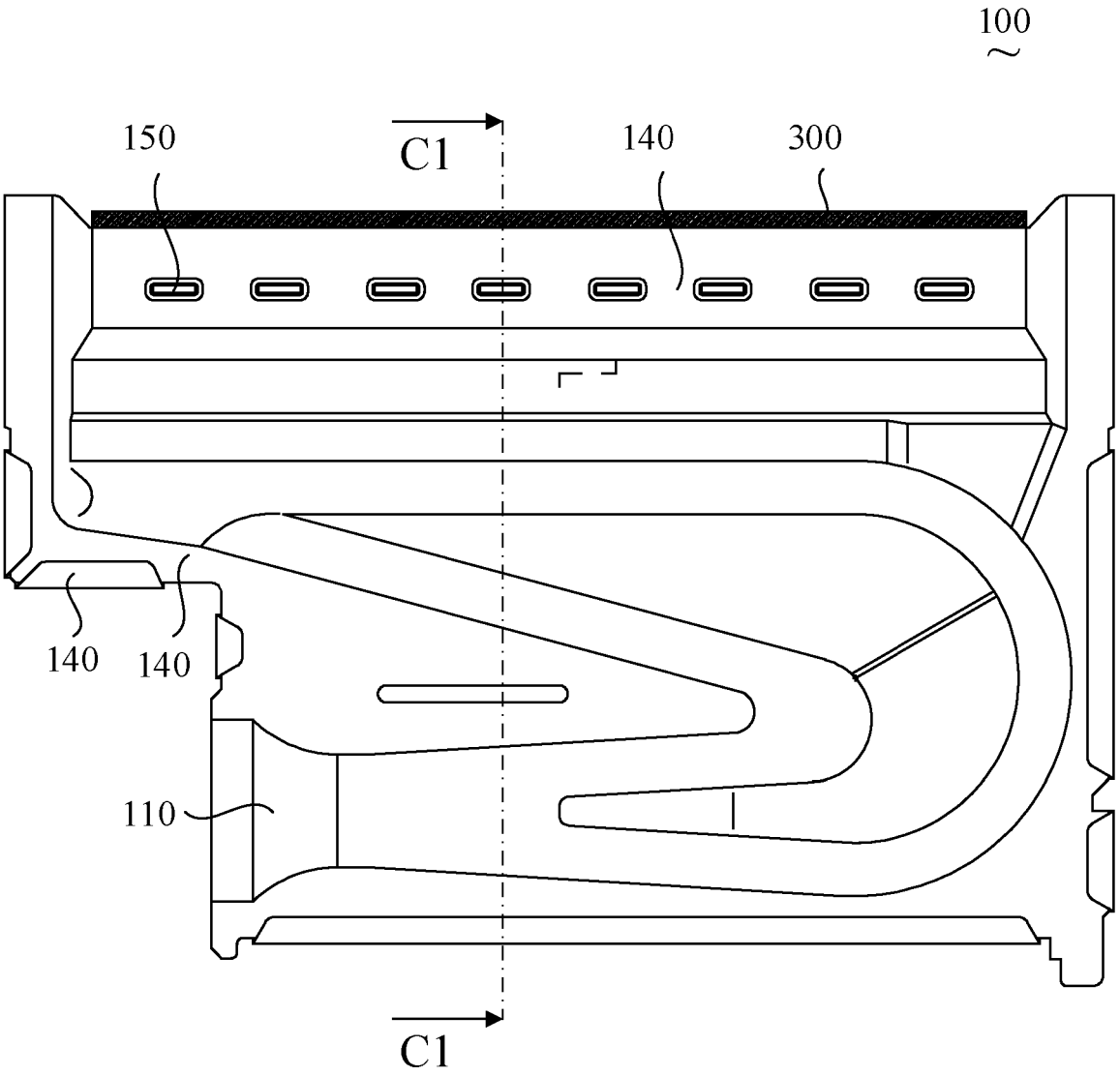

FIG. 28

C1-C1

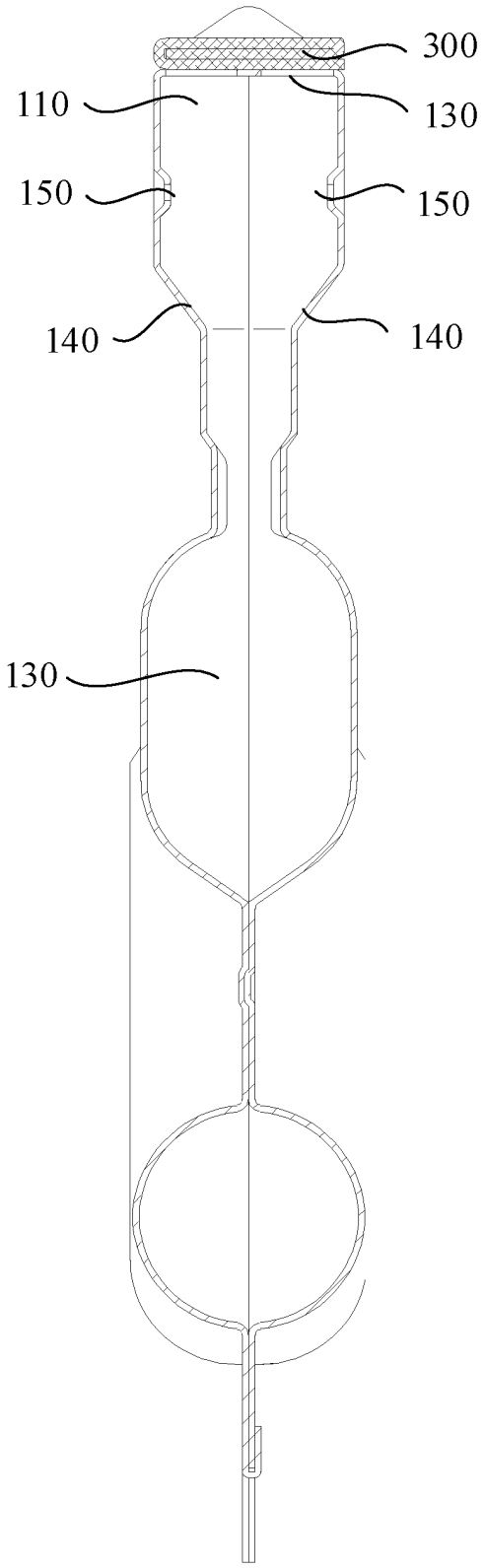

FIG. 29

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202120612600 **[0001]**
- CN 111735206 A **[0003]**
- US 20180087772 A1 **[0003]**
- CN 106765085 A **[0003]**