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(54) FIRE GRATE

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Description

[Technical Field]

[0001] The present invention relates to a grate bar.

[0002] Priority is claimed on Japanese Utility Model Application No. 2018-004543, filed November 22, 2018.

[Background Art]

[0003] As an incinerator which incinerates incineration materials such as refuse, a stoker type incinerator which can efficiently perform incineration without sorting a large amount of refuse is known. The stoker type incinerator has a stoker including a fixed grate bar stage and a moving grate bar stage which are alternately disposed in a transport direction of the refuse. The stoker type incinerator reciprocates the fixed grate bar stage and the moving grate bar stage to sufficiently stir and burn the refuse (for example, refer to Patent Literature 1).

[0004] Some stoker type incinerator have a cooling structure which cools the grate bar in order to improve durability and extend a life span of the stoker. As the cooling structure, for example, there is a structure in which cooling air is introduced into a cooling channel configured to be reciprocated serval times in the fire grate and an upper wall portion of the grate bar is cooled by forced convection. In the cooling structure by the forced convection, the cooling air flows along a wall of the grate bar which is a cooling target, and heat is transported through diffusion of vortices generated near the wall.

[Citation List]

[Patent Literature]

[0005] [Patent Literature 1]
Japanese Unexamined Patent Application, First Publication No. H06-265125

[Summary of Invention]

[0006] US 4 870 913 A, on which the two-part-form of claim 1 is based, CN 2 654 607 Y and JP S60 86730 U disclose other examples of grate coolers for cooling hot bulk material.

[Subject to be Solved]

[0007] In a stoker type incinerator for example, there is a possibility that a low air ratio operation or the like is performed, and thus, a temperature of a grate bar is further increased. In a case of a cooling structure using forced convection, for example, it is possible to improve cooling performance by increasing a flow velocity of cooling air.

[0008] However, for example, in a case of the stoker type incinerator in which the flow velocity of the cooling air cannot be increased, the cooling performance is insufficient, and there is a concern that the temperature of the grate bar increases.

[0009] Further, from the viewpoint of a life span of a material, further improvement in cooling performance is desired.

[0010] The present invention provides a grate bar having a cooling structure capable of improving cooling performance.

[Solution to Subject]

[0011] According to the first aspect of the present invention, a grate bar as defined in claim 1 is provided including: an upper wall portion which extends in a first direction; a front wall portion which extends downward from a distal end of the upper wall portion; a channel which is formed on a back side of the upper wall portion; and a partition wall which vertically divides the channel and includes a partition wall main body of which a main surface faces the upper wall portion and a plurality of cooling holes which are formed in the partition wall main body and which are configured to eject a cooling medium toward a back surface of the upper wall portion to cool the upper wall portion by impingement-cooling.

[0012] According to this configuration, the cooling medium ejected from the cooling holes directly collides with the upper wall portion. Therefore, cooling performance can be improved.

[0013] In the grate bar, when a distance between the partition wall and the upper wall portion is "L" and an inner diameter of the plurality of cooling holes are "Di", $2 < L/Di < 35$ may be satisfied.

[0014] According to this configuration, a dimensional tolerance can be increased when the grate bar is manufactured and a cost of a product can be reduced.

[0015] The grate bar may further include a slit which is formed to extend in the first direction on the distal end side from a center portion of the upper wall portion in the first direction and through which the cooling medium in the channel between the partition wall and the upper wall portion is discharged, in which the slit and the plurality of cooling holes may be formed so that the slit and the plurality of cooling holes do not overlap each other when viewed from a normal direction of a main surface of the upper wall portion.

[0016] According to this configuration, the slit functioning as an air discharge hole is formed in the upper wall portion, and thus, the air discharge hole can be increased. Therefore, a pressure loss due to the air discharge hole is reduced, and power of a blower fan for supplying the cooling air can be reduced.

[0017] Further, by shifting the positions of the slit and the cooling hole, the cooling medium ejected from the cooling hole reliably hits the upper wall portion. Therefore, the cooling performance of the impinging jet can be reliably obtained.

[0018] In the grate bar, the partition wall main body includes a main portion which is substantially parallel to the upper wall portion, and a distal end portion which is connected to the distal end side of the main portion, in which at least one of the plurality of cooling holes formed in the distal end portion is directed so that the cooling medium ejected from at least one of the plurality of cooling holes hits the front wall portion.

[0019] According to this configuration, the cooling medium ejected from the cooling hole hits not only the upper wall portion but also the front wall portion (the distal end of the grate bar). Therefore, the cooling performance of the distal end of the grate bar can be improved.

[0020] The grate bar may further include a plate-shaped fin which is provided integrally with the upper wall portion on the back surface of the upper wall portion and is formed to protrude downward from the upper wall portion.

[0021] According to this configuration, since the fin is formed on the upper wall portion, a heat radiation effect can be obtained. Therefore, the cooling performance of the grate bar is improved.

[0022] In the grate bar, the plurality of cooling holes may have a circular shape, and inner peripheral surfaces of the plurality of cooling holes may have a conical shape of which a diameter decreases upward.

[0023] According to this configuration, an inner diameter on an inlet side of the cooling hole increases. Therefore, a pressure loss due to the cooling hole can be reduced. In addition, an inner diameter on an outlet side of the cooling hole is reduced. Therefore, a flow velocity of the cooling medium can increase and the cooling performance can be improved.

[0024] According to a second aspect which is not part of the present invention, a grate bar is provided including: an upper wall portion which extends in a first direction; a front wall portion which extends downward from a distal end of the upper wall portion; a pair of side wall portions which extends downward from a side edge of the upper wall portion; and a duct which is disposed in a space surrounded by the upper wall portion and the pair of side wall portions and includes a tubular duct main body of which the distal end side is closed and which extends in the first direction, a plurality of cooling holes which are formed in the duct main body and are configured to inject a cooling medium toward a back surface of the upper wall portion, a back surface of the front wall portion, and back surfaces of the pair of side wall portions to perform impingement-cooling.

[0025] According to this configuration, when the cooling medium ejected from the duct is discharged, a gap between the side wall portion and the duct functions as a cooling medium discharge hole which is long in the first direction. Accordingly, even when a flow rate of the cooling medium increases, cooling efficiency of impinging jet is hardly obstructed by a flow of the cooling medium toward the cooling medium discharge hole, and an effect of the impinging jet can be maximized.

[0026] Further, a structure of the grate bar can be simplified. In addition, the structure of the grate bar is simplified, and thus, a maintenance of the grate bar is facilitated.

[Advantageous Effects of Invention]

[0027] According to the present invention, the cooling medium ejected from the cooling holes directly collides with the upper wall portion and the front wall portion, so that the cooling performance can be improved.

[Brief Description of Drawings]

[0028]

Fig. 1 is a schematic configuration view of a stoker type incinerator according to a first embodiment which is not part of the present invention.
Fig. 2 is a perspective view when the grate bar according to the first embodiment is viewed from above.
Fig. 3 is a perspective view when the grate bar according to the first embodiment is viewed from below.
Fig. 4 is a plan view when the grate bar according to the first embodiment is viewed from below.
Fig. 5 is a cross-sectional view taken along line V-V of Fig. 4 and is a cross-sectional view of the grate bar according to the first embodiment.
Fig. 6 is a view explaining an operation of the grate bar according to the first embodiment.
Fig. 7 is a perspective view when a grate bar according to a second embodiment which is not part of the present invention is viewed from above.
Fig. 8 is a cross-sectional view taken along line VIII-VIII of Fig. 7 and is a cross-sectional view of the grate bar according to the second embodiment.
Fig. 9 is a cross-sectional view of a grate bar according to a third embodiment which is not part of the present invention.
Fig. 10 is a cross-sectional view of a fire grate according to a fourth embodiment, which is part of the present invention.
Fig. 11 is a cross-sectional view of a grate bar according to a fifth embodiment which is not part of the present invention.
Fig. 12 is a cross-sectional view of a cooling hole and an air discharge hole of a grate bar according to a sixth embodiment which is not part of the present invention.
Fig. 13 is a perspective view of a grate bar according to a seventh embodiment which is not part of the present invention.
Fig. 14 is a cross-sectional view taken along line XIV-XIV of Fig. 13 and is a cross-sectional view of the grate bar according to the seventh embodiment.
Fig. 15 is a cross-sectional view taken along line XV-XV of Fig. 14 and is a cross-sectional view of the grate bar according to the seventh embodiment.

[Description of Embodiments]

(First Embodiment)

[0029] Hereinafter, a grate bar of a first embodiment which is not part of the present invention will be described in detail with reference to the drawings.

[0030] A grate bar is used in a stoker type incinerator for combustion of incineration materials such as refuse. As illustrated in Fig. 1, a stoker type incinerator 50 includes a charging hopper 51 which temporarily stores an incineration material "B", an incinerator 52 which burns the incineration material "B", a feeder 53 which supplies the incineration material "B" to the incinerator 52, a stoker 54 (including fire grates 1 of a drying stage 61, a combustion stage 62, and a post-combustion stage 63) which is provided on a bottom portion side of the incinerator 52, and a wind box 55 which is provided below the stoker 54.

[0031] The feeder 53 extrudes the incineration material "B", which is continuously supplied onto a feed table 56 via the charging hopper 51, into the incinerator 52. The feeder 53 reciprocates on the feed table 56 with a predetermined stroke by a feeder driving device 57.

[0032] The wind box 55 supplies primary air supplied from a blower (not illustrated) to each portion of the stoker 54.

[0033] The incinerator 52 is provided above the stoker 54 and has a combustion chamber 58 including a primary combustion chamber and a secondary combustion chamber. The incinerator 52 has a secondary air supply nozzle 59 which supplies secondary air to the combustion chamber 58.

[0034] The stoker 54 is a combustion device in which the grate bars 1 are arranged in a stepwise manner. The incineration material "B" burns on the stoker 54.

[0035] Hereinafter, a direction in which the incineration material "B" is transported is referred to as a transport direction "TD". The incineration material "B" is transported on the stoker 54 in the transport direction "TD". In Fig. 1, a right side is a downstream side TD1 in the transport direction.

[0036] The stoker 54 has a drying stage 61 which dries the incineration material "B", a combustion stage 62 which incinerates the incineration material "B", and a post-combustion stage 63 which completely incinerates (post-combustion) unburned combustibles, in order from an upstream side in the transport direction of the incineration material B. In the stoker 54, drying, combustion, and post-combustion are performed on the incineration material "B" while the incineration material "B" is sequentially transported in the drying stage 61, the combustion stage 62, and the post-combustion stage 63.

[0037] Each of the stages 61, 62, and 63 has a fixed grate bar stage having a plurality of fixed grate bars 1a and a moving grate bar stage having a plurality of moving grate bars 1b. The fixed grate bar stage is configured by disposing the plurality of fixed grate bars 1a in a width direction (a depth direction in Fig. 1) of the stoker 54. The moving grate bar stage is configured by disposing the plurality of moving grate bars 1b in the width direction of the stoker 54.

[0038] The fixed grate bar 1a (fixed grate bar stage) and the moving grate bar 1b (moving grate bar stage) are alternately disposed in the transport direction "TD". The moving grate bar 1b reciprocates in the transport direction "TD" of the incineration material B. The incineration material B on the stoker 54 is transported and agitated by the reciprocating motion of the moving grate bar 1b. That is, a lower portion of the incineration material "B" is moved and replaced with an upper portion of the incineration material "B".

[0039] The drying stage 61 receives the incineration material "B" which is extruded by the feeder 53 and dropped into the incinerator 52, and evaporates a moisture of the incineration material "B" and partially thermal-decomposes the incineration material "B". The combustion stage 62 ignites the incineration material "B" dried in the drying stage 61 by the primary air supplied from a lower wind box 55, and burns volatiles and fixed carbon components of the incineration material "B". The post-combustion stage 63 burns an unburned component such as a fixed carbon component which has passed without being burned in the combustion stage 62 until the unburned combustibles are completely turned into ash.

[0040] The ash is discharged from the incinerator 52 through a slag chute 64 provided at an outlet of the post-combustion stage 63.

[0041] Each of the stages 61, 62, and 63 has a drive mechanism 65 which drives the moving grate bars 1b.

[0042] In the stoker type incinerator 50, driving speeds of the moving grate bars 1b in the drying stage 61, the combustion stage 62, and the post-combustion stage 63 can be set to be the same or the driving speeds of at least some moving grate bars 1b in the drying stage 61, the combustion stage 62, and the post-combustion stage 63 can be set to be different from each other.

[0043] Next, shapes of the fixed grate bar 1a and the moving grate bar 1b of the present embodiment will be described. The shapes of the fixed grate bar 1a and the moving grate bar 1b are the same. Accordingly, hereinafter, the fixed grate bar 1a and the moving grate bar 1b will be described as the grate bar 1. However, some of the fixed grate bars 1a and the moving grate bars 1b may be grate bars having a projection. The grate bar having the projection has a projection protruding upward at a distal end of the grate bar 1, but the other structures are the same as those of the grate bar 1 described below.

[0044] The grate bar 1 of the present embodiment has a cooling structure. The grate bar 1 is cooled using the primary air supplied from the wind box 55 as cooling air (cooling medium).

[0045] As illustrated in Figs. 2, 3, 4, and 5, the grate bar 1 includes an upper wall portion 2 which extends in a first direction "D" (the transport direction "TD" of the refuse), a front wall portion 3 which extends downward from a distal end (an end portion on the downstream side TD1 in the transport direction) of the upper wall portion 2, a pair of side wall portions 4 which extends downward from a side edge 2a of the upper wall portion 2, and a rear wall portion 5. An upper surface of the upper wall portion 2 is a surface on which the refuse is placed.

[0046] The upper wall portion 2, the front wall portion 3, the pair of side wall portions 4, and the rear wall portion 5 are formed integrally. A concave portion 6 is formed at a rear end of the upper wall portion 2.

[0047] The concave portion 6 of the grate bar 1 is fitted into a convex portion (not illustrated) provided on each of installation surfaces 61a, 62a, and 63a (refer to Fig. 1) of the respective stages 61, 62, and 63. Thereby, the grate bars 1 are attached to each of the stages 61, 62, and 63.

[0048] The upper wall portion 2 has a rectangular shape and forms an upper surface of the stoker 54 together with the grate bar 1 adjacent in a width direction "W" (a direction orthogonal to the first direction "D").

[0049] The front wall portion 3 is formed so as to protrude downward from the upper wall portion 2 so that a main surface of the upper wall portion 2 and a main surface of the front wall portion 3 intersect each other at an angle close to a right angle. A thickness of the front wall portion 3 is larger than thicknesses of the upper wall portion 2 and the side wall portion 4.

[0050] The side wall portion 4 is formed so that the main surface of the upper wall portion 2 and a main surface of the side wall portion 4 intersect each other at a substantially right angle. The side wall portion 4 is formed so that a width thereof increases toward the distal end of the grate bar 1.

[0051] The rear wall portion 5 has a plate shape protruding downward from the upper wall portion 2 and is formed so that a main surface of the rear wall portion 5 faces the first direction "D". The rear wall portion 5 is disposed in a rear portion (between the front wall portion 3 and the concave portion 6 and on the concave portion 6 side) of the grate bar 1.

[0052] A channel "S" is formed below the upper wall portion 2 (on a back side of the upper wall portion 2).

[0053] The grate bar 1 includes the upper wall portion 2, the front wall portion 3, the pair of side wall portions 4, and a partition wall 8 that vertically divides the channel "S". The partition wall 8 has a plate shape and is attached so as to be parallel to the upper wall portion 2.

[0054] The partition wall 8 has a partition wall main body 9 of which a main surface faces the upper wall portion 2 and which divides the channel "S" into an upper channel S1 between the upper wall portion 2 and the partition wall 8 and a lower channel S2 below the partition wall 8, and a plurality of cooling holes 10 which are formed in the partition wall main body 9.

[0055] The plurality of cooling holes 10 are uniformly disposed in the partition wall main body 9. For example, the plurality of cooling holes 10 can be disposed in a lattice shape. The number and sizes of the plurality of cooling holes 10 are set so that the grate bar 1 does not float due to a pressure loss of the cooling hole 10, that is, the pressure loss may be set to 500 mmAq (4.90 kPa) or less.

[0056] An air discharge hole 12 through which the cooling air is discharged from the upper channel S1 is formed in the side wall portion 4. The air discharge hole 12 is disposed on a distal end side in the first direction "D".

[0057] As illustrated in Fig. 6, when an inner diameter of the cooling hole 10 is indicated by "Di" and a distance between an upper surface of the partition wall 8 and a lower surface of the upper wall portion 2 is indicated by "L", the partition wall 8 is disposed so that a ratio L/Di between the inner diameter "Di" and the distance "L" satisfies 2 < "L/Di" < 35.

[0058] Next, an operation of the grate bar 1 of the present embodiment will be described.

[0059] As illustrated in Fig. 6, when the primary air (cooling air) supplied from the wind box 55 (refer to Fig. 1) is introduced into the lower channel S2, the cooling air "C" passes through the plurality of cooling holes 10 which are formed in the partition wall 8, and is ejected to a back surface of the upper wall portion 2. The cooling air "C" flows so as to collide with the upper wall portion 2, and thereafter, the cooling air "C" is discharged from the air discharge holes 12. Thereby, the upper wall portion 2 is impingement-cooled.

[0060] According to the embodiment, the cooling air "C" ejected from the cooling holes 10 directly collides with the upper wall portion 2 and the cooling air "C" directly transports heat. Therefore, heat transfer coefficient increases. As a result, cooling performance can be improved. That is, the cooling air "C" collides with the upper wall portion 2, and thus, the cooling performance of the grate bar 1 can be improved.

[0061] Moreover, by setting the ratio "L/Di" between the inner diameter "Di" and the distance L to 2 <" L/Di" < 35, a dimensional tolerance can be increased when the grate bar 1 is manufactured. As a result, a cost of a product can be reduced.

[0062] In the embodiment, a shape of the cooling hole 10 is circular, but the shape is not limited to this. For example, the shape of the cooling hole 10 may be elliptical or polygonal.

[0063] Moreover, in the embodiment, the cooling medium used for cooling is the primary air. However, the embodiment is not limited to this, and for example, steam may be supplied to the grate bar 1 to perform cooling.

[0064] Further, in the embodiment, the air discharge holes 12 are formed in a square shape, but the embodiment is not limited to this. For example, the air discharge holes 12 may be circular or elliptical.

(Second Embodiment)

[0065] Hereinafter, a grate bar of a second embodiment which is not part of the present invention will be described in detail with reference to the drawings. In the present embodiment, differences from the above-described first embodiment will be mainly described, and descriptions of the same portions will be omitted.

[0066] As illustrated in Fig. 7, a plurality of air discharge holes 12B of the grate bar 1 of the present embodiment are formed in the upper wall portion 2. Each of the plurality of air discharge holes 12B has a slit shape (a long hole) extending in the first direction "D". The plurality of air discharge holes 12B are formed closer to the distal end side than a center portion of the upper wall portion 2 in the first direction "D". The air discharge holes 12B are formed at equal intervals in the width direction "W".

[0067] An area of each air discharge hole 12B is set such that the flow velocity of the cooling air discharged from the air discharge hole 12B is equal to or higher than terminal velocities of dust particles.

[0068] As illustrated in Fig. 8, the number of the air discharge holes 12B and position of the air discharge holes 12B in the width direction "W" correspond to those of the cooling holes 10. When viewed from a normal direction (above the upper wall portion 2) of the main surface of the upper wall portion 2, the air discharge holes 12 and the cooling holes 10 overlap each other.

[0069] However, the number of the air discharge holes 12B and the positions of the air discharge holes 12B in the width direction "W" need not correspond to the cooling holes 10. That is, when viewed from the normal direction of the main surface of the upper wall portion 2, the air discharge holes 12 and the cooling holes 10 may not overlap each other.

[0070] According to the embodiment, the slit-shaped air discharge holes 12B are provided in the upper wall portion 2 of the grate bar 1B, and thus, the degree of freedom in a size and shape of the air discharge hole 12B can be improved.

[0071] In addition, when the flow velocity of the cooling air ejected from the cooling holes 10 increases, the cooling performance is improved. However, as a contradiction event, the pressure loss due to the partition wall 8 (perforated plate) increases. When the pressure loss increases, floating of the grate bar 1 becomes a problem. Therefore, an upper limit of the flow velocity of the cooling air is determined by the pressure loss of the entire grate bar by the partition wall 8 and the air discharge hole 12. By forming the plurality of air discharge holes 12B in the upper wall portion 2 or increasing the size of the air discharge hole 12B as in the grate bar 1B of the embodiment, the pressure loss due to the air discharge hole 12B is reduced. As a result, power of a blowing fan for supplying the cooling air can be reduced.

(Third Embodiment)

[0072] Hereinafter, a grate bar of a third embodiment which is not part of the present invention will be described in detail with reference to the drawings. In the present embodiment, differences from the above-described second embodiment will be mainly described, and descriptions of the same portions will be omitted.

[0073] As illustrated in Fig. 9, in a fire grate 1C of the present embodiment, the air discharge holes 12B and the cooling holes 10 do not overlap each other when viewed from the normal direction of the main surface of the upper wall portion 2. Specifically, four air discharge holes 12B are formed in the width direction "W". The cooling holes 10 are formed between the air discharge holes 12B adjacent to each other in the width direction "W" when viewed from the normal direction of the main surface of the upper wall portion 2. That is, air ejected from the cooling holes 10 hits the upper wall portion 2 and is then discharged from the air discharge holes 12B.

[0074] According to the embodiment, by shifting the positions of the air discharge holes 12B and the cooling holes 10, the cooling air ejected from the cooling holes 10 reliably hits the upper wall portion 2. Therefore, cooling performance of the impinging jet can be reliably obtained even at locations where the slit-shaped air discharge holes 12B are formed.

(Fourth Embodiment)

[0075] Hereinafter, a grate bar of a fourth embodiment which is part of the present invention will be described in detail with reference to the drawings. In the present embodiment, differences from the above-described second embodiment will be mainly described, and descriptions of the same portions will be omitted.

[0076] As illustrated in Fig. 10, a partition wall main body 9D of the partition wall 8 of the present embodiment includes a main portion 14 which is substantially parallel to the upper wall portion 2 and a distal end portion 15 which is connected to a distal end side of the main portion 14. The distal end portion 15 is formed such that a main surface of the distal end portion 15 is substantially parallel to the front wall portion 3. The main portion 14 and the distal end portion 15 are smoothly connected to each other. At least some of the plurality of cooling holes 10 formed in the distal end portion 15 are directed so that the cooling air "C" ejected from the cooling holes 10 hits the front wall portion 3.

[0077] According to the embodiment, the cooling air "C" ejected from the cooling holes 10 hits not only the upper wall portion 2 but also the front wall portion 3 (a distal end of the grate bar 1D). Therefore, cooling performance of the distal end of the grate bar 1D can be improved.

[0078] In the embodiment, the distal end portion 15 is formed so as to be substantially parallel to the front wall portion 3. However, the present invention is not limited to this as long as the distal end portion 15 is formed so that the cooling air "C" ejected from the cooling holes 10 hits the front wall portion 3. For example, an angle between the main portion 14 and the distal end portion 15 may be obtuse, or the distal end portion 15 may be a plate having a curvature.

(Fifth Embodiment)

[0079] Hereinafter, a grate bar of a fifth embodiment which is not part of the present invention will be described in detail with reference to the drawings. In the present embodiment, differences from the above-described second embodiment will be mainly described, and descriptions of the same portions will be omitted.

[0080] As illustrated in Fig. 11, a grate bar 1E of the present embodiment has fins 16 formed on the upper wall portion 2. Each of the fins 16 has a plate shape and is provided integrally with the upper wall portion 2 on a back surface 2b of the upper wall portion 2. The fin 16 is formed so as to protrude downward from the upper wall portion 2.

[0081] The fin 16 is formed such that the main surface of the fin 16 is along the first direction "D" and faces the width direction "W".

[0082] According to the embodiment, the fins 16 are formed on the upper wall portion 2. Accordingly, a heat radiation effect can be obtained. Therefore, cooling performance of the grate bar 1E is improved.

(Sixth Embodiment)

[0083] Hereinafter, a grate bar of a sixth embodiment which is not part of the present invention will be described in detail with reference to the drawings. In the present embodiment, differences from the above-described second embodiment will be mainly described, and descriptions of the same portions will be omitted.

[0084] As illustrated in Fig. 12, a cooling hole 10F of a grate bar 1F of the present embodiment has a circular shape. An inner peripheral surface 10a of the cooling hole 10F has a conical shape of which a diameter decreases upward (toward the upper wall portion 2). The cooling hole 10F is formed such that Di1 > Di2 is satisfied, where Di1 is an inner diameter of a lower end and Di2 is an inner diameter of an upper end.

[0085] According to the embodiment, the inner diameter Di1 on an inlet side of the cooling hole 10F increases. Therefore, a pressure loss due to the cooling hole 10F can be reduced. Further, the inner diameter Di2 on an outlet side of the cooling hole 10F is reduced. Therefore, a flow velocity of the cooling air can increase and the cooling performance can be improved.

(Seventh Embodiment)

[0086] Hereinafter, a grate bar of a seventh embodiment which is not part of the present invention will be described in detail with reference to the drawings. In the present embodiment, differences from the above-described first embodiment will be mainly described, and descriptions of the same portions will be omitted.

[0087] As illustrated in Figs. 13, 14, and 15, a grate bar 1G of the present embodiment includes the upper wall portion 2, the front wall portion 3, the pair of side wall portions 4, the rear wall portion 5, and a duct 18 which is fixed to the rear wall portion 5 and extends in the first direction "D".

[0088] The duct 18 is disposed in a space surrounded by the upper wall portion 2 and the pair of side wall portions 4. The duct 18 has a rectangular tubular duct main body 19 which extends in the first direction "D", a plurality of cooling holes 10 which are formed in the duct main body 19 and injects the cooling air "C" toward the back surface of the upper wall portion 2, the back surface of the front wall portion 3, the back surfaces of the pair of side wall portions 4 to perform impingement-cooling, and an air introduction hole 11 which is formed on a rear end of the duct main body 19.

[0089] The duct main body 19 has a first surface 21 which is parallel to the upper wall portion 2, a pair of second surfaces 22 which is parallel to the side wall portions 4, a third surface 23 which is parallel to the first surface 21 and forms a rectangular tube together with the first surface 21 and the pair of second surfaces 22, and a fourth surface 24 which closes a distal end of the duct main body 19.

[0090] The cooling holes 10 are regularly formed in the first surface 21 and the pair of second surfaces 22. An axis A of each cooling hole 10 formed in the second surface 22 is not orthogonal to the second surface 22 and is inclined. The cooling hole 10 formed in the second surface 22 is inclined so that an outer side of the cooling hole 10 is higher. Accordingly, the cooling air "C" ejected from the cooling hole 10 is ejected upward.

[0091] As illustrated in Figs. 14 and 15, the cooling air ejected from the cooling holes 10 of the duct 18 hits the upper wall portion 2, the side wall portions 4, and the front wall portion 3 so as to cool the wall portions. Thereafter, the cooling air is discharged from the gap "G" between the side wall portions 4 and the duct 18 on a bottom side of the grate bar 1.

[0092] For example, in the grate bar 1B (refer to Fig. 7 and Fig.8) of the second embodiment, if a flow rate of the cooling air flowing through the upper channel S 1 increases, impinging jet near the air discharge holes 12B hardly contributes to cooling due to the flow (cross flow) of the cooling air discharged from the air discharge holes 12B along the upper wall portion 2. That is, energy of the impinging jet hitting an inner surface of the wall from the cooling holes 10 is weakened by the cooling air flowing along the wall toward the air discharge hole 12.

[0093] Meanwhile, according to the grate bar 1G of the present embodiment, the gap "G" between the side wall portions 4 and the duct 18 functions as an air discharge hole that is long in the first direction "D", and thus, the cross flow is eliminated. Therefore, effects of the impinging jet can be maximized.

[0094] Further, since it is not necessary to weld the partition wall 8 to the main body side of the grate bar 1G, the structure of the grate bar 1G can be simplified. In addition, the structure of the grate bar 1G is simplified, and thus, a maintenance of the grate bar 1G is facilitated.

[0095] In the embodiment, a shape of the duct main body 19 is a rectangular tube. However, the shape of the duct main body 19 is not limited to this as long as the duct main body 19 is tubular. For example, the shape of the duct main body 19 may be cylindrical.

[0096] As described above, the embodiments of the present invention are described in detail with reference to the drawings. However, the specific configurations are not limited to the embodiments and include design modifications or the like within a scope which does not depart from the gist of the present invention as defined in the appended claims.

[Industrial Applicability]

[0097] According to the present invention, the cooling medium ejected from the cooling holes directly collides with the upper wall portion and the front wall portion, so that the cooling performance can be improved.

[Reference Signs List]

[0098]

1, 1B, 1C, 1D, 1E, 1F, 1G: grate bar
1a: fixed grate bar
1b: moving grate bar
2: upper wall portion
3: front wall portion
4: side wall portion
5: rear wall portion
6: concave portion
8: partition wall
9, 9D: partition wall main body
10: cooling hole
11: air introduction hole
12, 12B: air discharge hole
14: main portion
15: distal end portion
16: fin
18: duct
19: duct main body
21: first surface
22: second surface
23: third surface
24: fourth surface
50: stoker type incinerator
51: charging hopper
52: incinerator
53: feeder
54: stoker
55: wind box
56: feed table
57: feeder driving device
58: combustion chamber
59: secondary air supply nozzle
61: drying stage
62: combustion stage
63: post-combustion stage
64: slag chute
65: drive mechanism
B: incineration material
C: cooling air
D: first direction
S: channel
S1: upper channel
S2: lower channel
TD: transport direction
TD1: downstream side in transport direction
W: width direction

Claims

1. A grate bar (1, 1B, 1C, 1D, 1E, 1F, 1G) comprising:

an upper wall portion (2) which extends in a first direction (D);
a front wall portion (3) which extends downward from a distal end of the upper wall portion (2);
a channel (S) which is formed on a back side of the upper wall portion (2); and
a partition wall (8) which vertically divides the channel (S) and includes a partition wall main body (9D) of which a main surface faces the upper wall portion (2) and a plurality of cooling holes (10) which are formed in the partition wall main body (9D) and which are configured to eject a cooling medium (C) toward a back surface of the upper wall portion (2) to cool the upper wall portion (2) by impingement-cooling,
characterized in that the grate bar comprises a pair of side wall portions (4) which extends downward from a side edge (2a) of the upper wall portion (2); and
a rear wall portion (5) which has a plate shape protruding downward from the upper wall portion (2) and formed so that a main surface of the rear wall portion (5) faces the first direction (D),
wherein the upper wall portion (2), the front wall portion (3), the pair of side wall portions (4), and the rear wall portion (5) are formed integrally,
wherein the partition wall main body (9D) is connected to the front wall portion (3), the pair of side wall portions (4), and the rear wall portion (5),
wherein the partition wall main body (9D) divides the channel (S) into an upper channel (S1) between the upper wall portion (2) and the partition wall main body (9D) and a lower channel (S2) below the partition wall main body (9D),
wherein the partition wall main body (9D) includes

a main portion (14) which is parallel to the upper wall portion (2), and a distal end portion (15) which is connected to a distal end side of the main portion (14), and

wherein at least one of the plurality of cooling holes (10) formed in the distal end portion (15) is directed so that the cooling medium (C) ejected from at least one of the plurality of cooling holes (10) is configured to hit the front wall portion (3) in the upper channel (S1).

2. The grate bar (1, 1B, 1C, 1D, 1E, 1F, 1G) according to claim 1,
wherein when a distance between the partition wall (8) and the upper wall portion (2) is "L" and an inner diameter of the plurality of cooling holes (10) are "Di",
2 < "L/Di" < 35 is satisfied.

3. The grate bar (1, 1B, 1C, 1D, 1E, 1F, 1G) according to claim 1 or 2, further comprising:

a slit (12B) which is formed to extend in the first direction (D) on the distal end side from a center portion of the upper wall portion (2) in the first direction (D) and through which the cooling medium (C) in the channel (S) between the partition wall (8) and the upper wall portion (2) is discharged,
wherein the slit (12B) and the plurality of cooling holes (10) are formed so that the slit (12B) and the plurality of cooling holes (10) do not overlap each other when viewed from a normal direction of a main surface of the upper wall portion (2).

4. The grate bar (1, 1B, 1C, 1D, 1E, 1F, 1G) according to any one of claims 1 to 3, further comprising:
a plate-shaped fin (16) which is provided integrally with the upper wall portion (2) on the back surface of the upper wall portion (2) and is formed to protrude downward from the upper wall portion (2).

5. The grate bar (1, 1B, 1C, 1D, 1E, 1F, 1G) according to any one of claims 1 to 3,
wherein the plurality of cooling holes (10F) have a circular shape, and inner peripheral surfaces (10a) of the plurality of cooling holes (10F) have a conical shape of which a diameter decreases upward.

Patentansprüche

1. Roststab (1, 1B, 1C, 1D, 1E, 1F, 1G), umfassend:

einen oberen Wandabschnitt (2), der sich in eine erste Richtung (D) erstreckt,
einen vorderen Wandabschnitt (3), der sich von einem distalen Ende des oberen Wandabschnitts (2) nach unten erstreckt;
einen Kanal (S), der auf einer hinteren Seite des oberen Wandabschnitts (2) gebildet ist;
und eine Teilungswand (8), die den Kanal (S) vertikal unterteilt und einen Teilungswandhauptkörper (9D) beinhaltet, von dem eine Hauptoberfläche dem oberen Wandabschnitt (2) gegenüberliegt, und eine Vielzahl von Kühlungslöchern (10), die im Teilungswandhauptkörper (9D) gebildet sind, und die konfiguriert sind, um ein Kühlmedium (C) hin zu einer hinteren Oberfläche des oberen Wandabschnitts (2) auszustoßen, um den oberen Wandabschnitt (2) durch Aufprallkühlung zu kühlen,
dadurch gekennzeichnet, dass der Roststab ein Paar Seitenwandabschnitte (4) umfasst, die sich von einer Seitenkante (2a) des oberen Wandabschnitts (2) nach unten erstrecken; und einen hinteren Wandabschnitt (5), der eine Plattenform aufweist, die vom oberen Wandabschnitt (2) nach unten vorspringt und derart geformt ist, dass die Hauptoberfläche des hinteren Wandabschnitts (5) der ersten Richtung (D) gegenüberliegt, wobei der obere Wandabschnitt (2), der vordere Wandabschnitt (3), das Paar Seitenwandabschnitte (4) und der hintere Wandabschnitt (5) einstückig gebildet sind,
wobei der Teilungswandhauptkörper (9D) mit dem vorderen Wandabschnitt (3), dem Paar Seitenwandabschnitten (4) und dem hinteren Wandabschnitt (5) verbunden ist,
wobei der Teilungswandhauptkörper (9D) den Kanal (S) in einen oberen Kanal (S1) zwischen dem oberen Wandabschnitt (2) und dem Teilungswandhauptkörper (9D) und einen unteren Kanal (S2) unter dem Teilungswandhauptkörper (9D) unterteilt,
wobei der Teilungswandhauptkörper (9D) Folgendes beinhaltet;
einen Hauptabschnitt (14), der parallel zum oberen Wandabschnitt (2) ist, und
einen distalen Abschnitt (15), der mit einer distalen Endseite des Hauptabschnitts (14) verbunden ist, und
wobei mindestens eines der Vielzahl von Kühlungslöchern (10), die im distalen Ende (15) gebildet sind, derart ausgerichtet ist, dass das Kühlmedium (C), das von mindestens einem der Vielzahl von Kühlungslöchern (10) ausgestoßen wird, konfiguriert ist, um auf den vorderen Wandabschnitt (3) im oberen Kanal (S1) zu treffen.

2. Roststab (1, 1B, 1C, 1D, 1E, 1F, 1G) nach Anspruch 1,
wobei, wenn eine Distanz zwischen der Teilungs-

wand (8) und dem oberen Wandabschnitt (2) "L" ist und ein Innendurchmesser der Vielzahl von Kühlungslöchern (10), "Di" ist, 2 < "L/Di" < 35 erfüllt ist.

3. Roststab (1, 1B, 1C, 1D, 1E, 1F, 1G) nach Anspruch 1 oder 2, weiter umfassend:

einen Schlitz (12B), der geformt ist, um sich in der ersten Richtung (D) auf der distalen Endseite von einem zentralen Abschnitt des oberen Wandabschnitts (2) in der ersten Richtung (D) zu erstrecken, und durch den das Kühlmedium (C) im Kanal (S) zwischen der Teilungswand (8) und dem oberen Wandabschnitt (2) entladen wird,
wobei der Schlitz (12B) und die Vielzahl von Kühlungslöchern (10) derart geformt sind, dass der Schlitz (12B) und die Vielzahl von Kühlungslöchern (10) einander nicht überlappen, wenn aus einer normalen Richtung der Hauptoberfläche des oberen Wandabschnitts (2) betrachtet.

4. Roststab (1, 1B, 1C, 1D, 1E, 1F, 1G) nach einem der Ansprüche 1 bis 3, weiter umfassend:
eine plattenförmige Rippe (16), die einstückig mit dem oberen Wandabschnitt (2) auf der hinteren Oberfläche des oberen Wandabschnitts (2) bereitgestellt und geformt ist, um vom oberen Wandabschnitt (2) nach unten vorzuspringen (2).

5. Roststab (1, 1B, 1C, 1D, 1E, 1F, 1G) nach einem der Ansprüche 1 bis 3,
wobei die Vielzahl von Kühlungslöchern (10F) eine runde Form aufweisen und innere Umfangsoberflächen (10a) der Vielzahl von Kühlungslöchern (10F) eine konische Form aufweisen, deren Durchmesser nach oben abnimmt.

Revendications

1. Barreau de grille (1, 1B, 1C, 1D, 1E, 1F, 1G) comprenant :

une partie de paroi supérieure (2) qui s'étend dans une première direction (D) ;
une partie de paroi avant (3) qui s'étend vers le bas depuis une extrémité distale de la partie de paroi supérieure (2) ;
un canal (S) qui est formé sur un côté arrière de la partie de paroi supérieure (2) ; et
une paroi de séparation (8) qui divise verticalement le canal (S) et comprend un corps principal de paroi de séparation (9D) dont une surface principale fait face à la partie de paroi supérieure (2) et une pluralité de trous de refroidissement (10) qui sont formés dans le corps principal de paroi de séparation (9D) et qui sont configurés pour éjecter un agent de refroidissement (C) vers une surface arrière de la partie de paroi supérieure (2) pour refroidir la partie de paroi supérieure (2) par refroidissement par impact,
caractérisé en ce que le barreau de grille comprend une paire de parties de paroi latérale (4) qui s'étend vers le bas depuis un bord latéral (2a) de la partie de paroi supérieure (2) ; et
une partie de paroi arrière (5) qui a une forme de plaque faisant saillie vers le bas depuis la partie de paroi supérieure (2) et formée de sorte qu'une surface principale de la partie de paroi arrière (5) fait face à la première direction (D),
dans lequel la partie de paroi supérieure (2), la partie de paroi avant (3), la paire de parties de paroi latérale (4) et la partie de paroi arrière (5) sont formées d'un seul tenant,
dans lequel le corps principal de paroi de séparation (9D) est relié à la partie de paroi avant (3), à la paire de parties de paroi latérale (4) et à la partie de paroi arrière (5),
dans lequel le corps principal de paroi de séparation (9D) divise le canal (S) en un canal supérieur (S1) entre la partie de paroi supérieure (2) et le corps principal de paroi de séparation (9D) et un canal inférieur (S2) au-dessous de la paroi de séparation corps principal (9D),
dans lequel le corps principal de paroi de séparation (9D) comprend
une partie principale (14) qui est parallèle à la partie de paroi supérieure (2), et
une partie d'extrémité distale (15) qui est reliée à un côté d'extrémité distale de la partie principale (14), et
dans lequel au moins un de la pluralité de trous de refroidissement (10) formés dans la partie d'extrémité distale (15) est dirigé de sorte que l'agent de refroidissement (C) éjecté d'au moins un de la pluralité de trous de refroidissement (10) est configuré pour frapper la partie de paroi avant (3) dans le canal supérieur (S1).

2. Barreau de grille (1, 1B, 1C, 1D, 1E, 1F, 1G) selon la revendication 1,

dans lequel, lorsqu'une distance entre la paroi de séparation (8) et la partie de paroi supérieure (2) est « L » et un diamètre interne de la pluralité de trous de refroidissement (10) est « D »,
2 < « L/Di » < 35 est satisfait.

3. Barreau de grille (1, 1B, 1C, 1D, 1E, 1F, 1G) selon la revendication 1 ou 2, comprenant en outre :

une fente (12B) qui est formée pour s'étendre dans la première direction (D) sur le côté d'extrémité distale à partir d'une partie centrale de la partie de paroi supérieure (2) dans la première

direction (D) et à travers laquelle l'agent de refroidissement (C) dans le canal (S) entre la paroi de séparation (8) et la partie de paroi supérieure (2) est évacué,
dans lequel la fente (12B) et la pluralité de trous de refroidissement (10) sont formés de sorte que la fente (12B) et la pluralité de trous de refroidissement (10) ne se chevauchent pas lorsqu'ils sont observés depuis une direction normale d'une surface principale de la partie de paroi supérieure (2).

4. Barreau de grille (1, 1B, 1C, 1D, 1E, 1F, 1G) selon la revendication 1 ou 3, comprenant en outre :
une ailette en forme de plaque (16) qui fait partie intégrante de la partie de paroi supérieure (2) sur la surface arrière de la partie de paroi supérieure (2) et est formée pour faire saillie vers le bas depuis la partie de paroi supérieure (2).

5. Barreau de grille (1, 1B, 1C, 1D, 1E, 1F, 1G) selon l'une quelconque des revendications 1 à 3, dans lequel la pluralité de trous de refroidissement (10F) ont une forme circulaire, et des surfaces périphériques internes (10a) de la pluralité de trous de refroidissement (10F) ont une forme conique dont un diamètre diminue vers le haut.

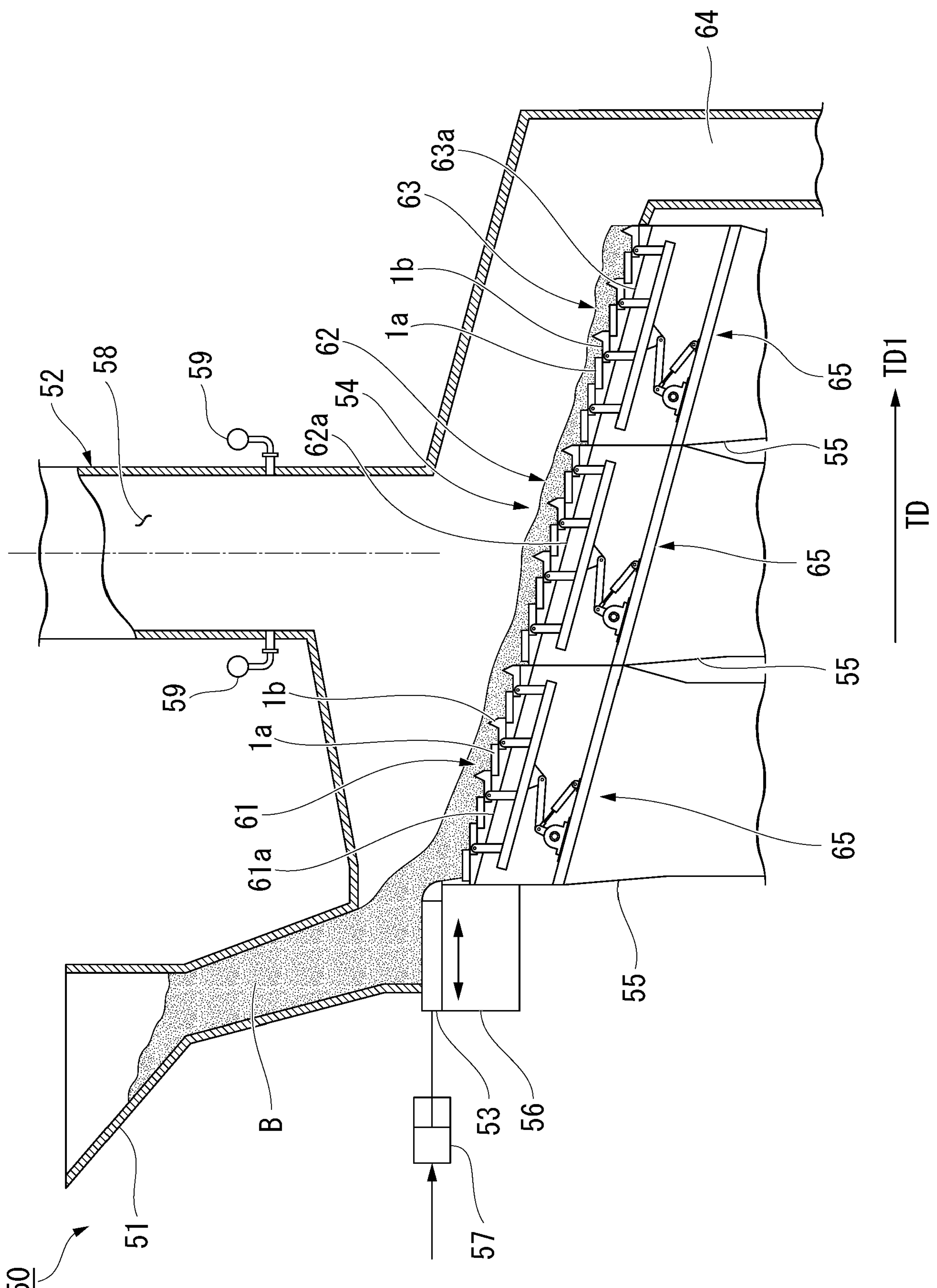

50
51
B
52
58
59
59
64
63a
63
1b
1a
62
62a
54
1b
1a
61
61a
53
56
57
55
55
55
55
65
65
65
TD
TD1

FIG. 1

FIG. 2

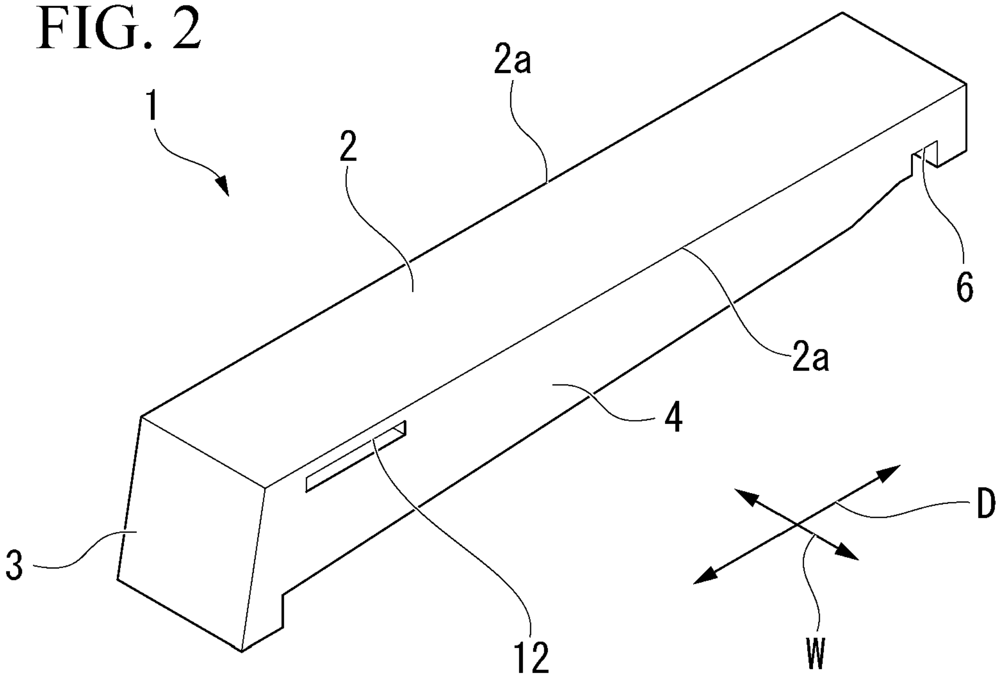


FIG. 3

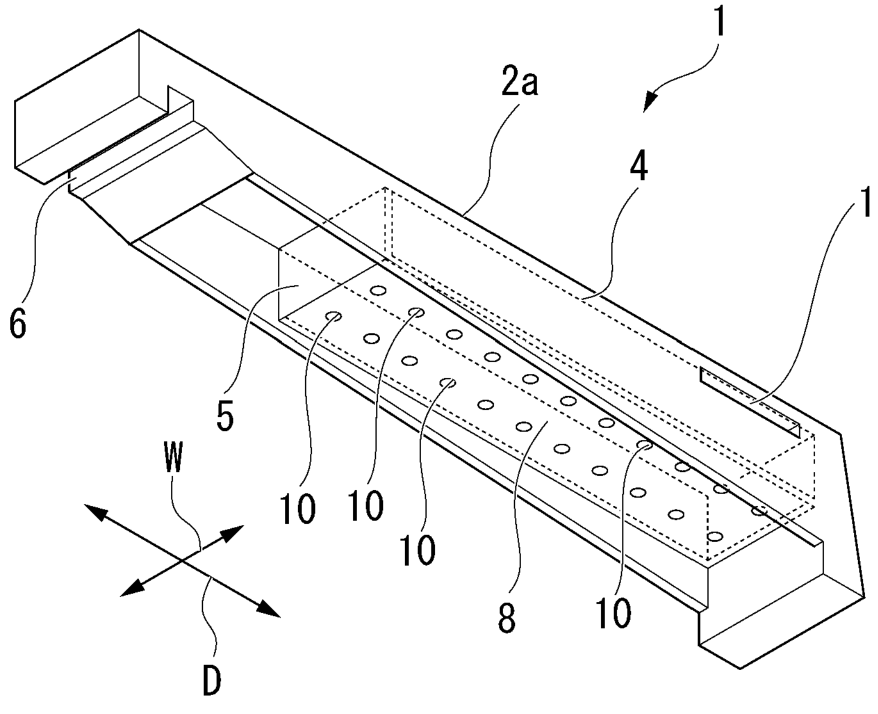


FIG. 4

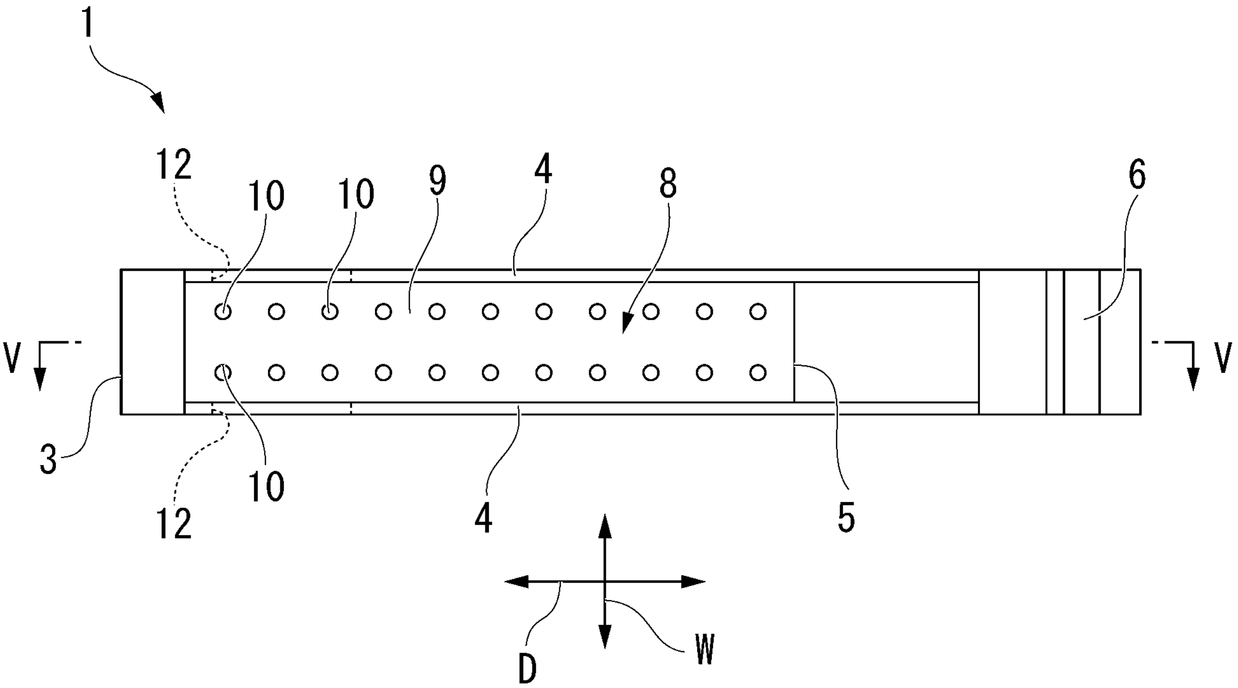


FIG. 5

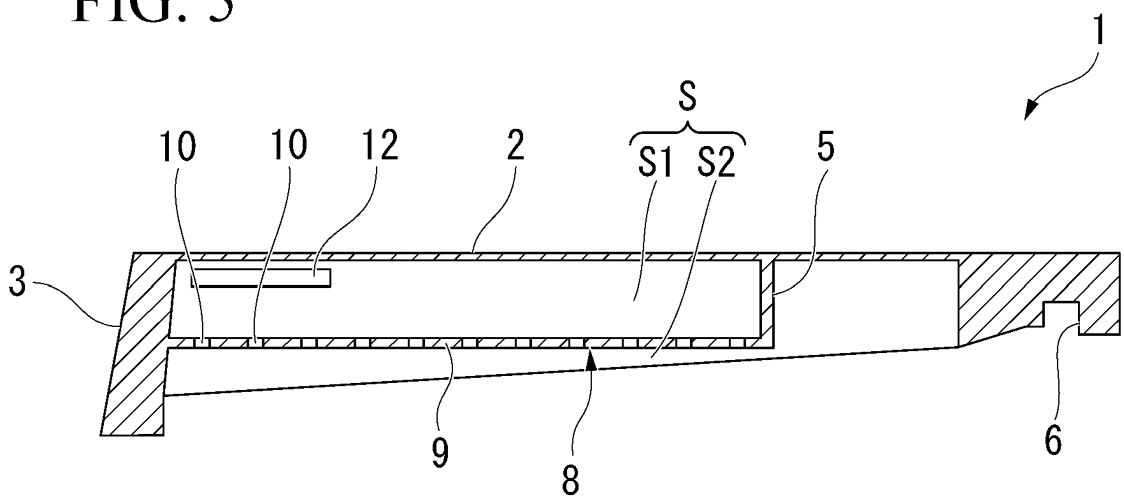


FIG. 6

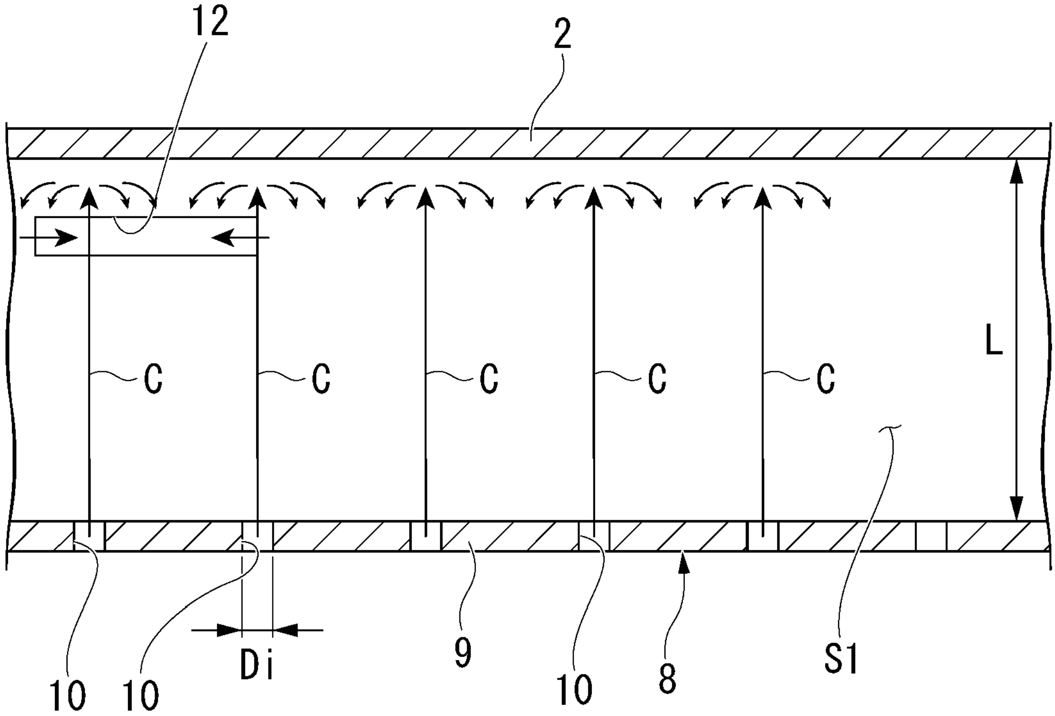

12
2
C
C
C
C
C
L
S1
10
10
Di
9
10
8

FIG. 7

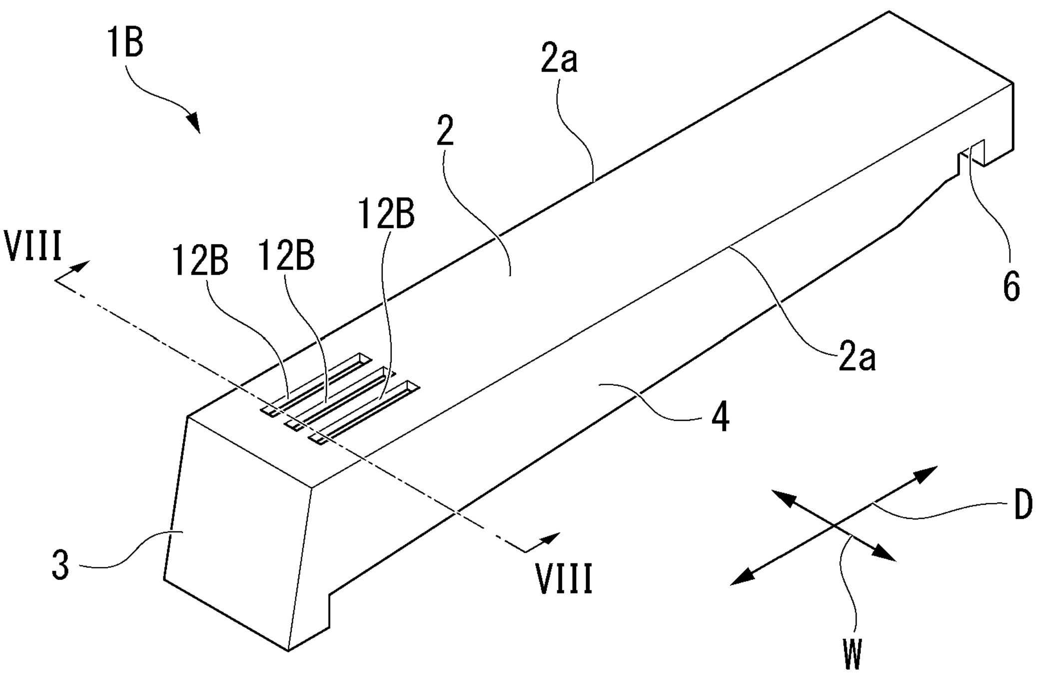

1B
2a
2
12B
12B
12B
VIII
VIII
6
2a
4
3
D
W

FIG. 8

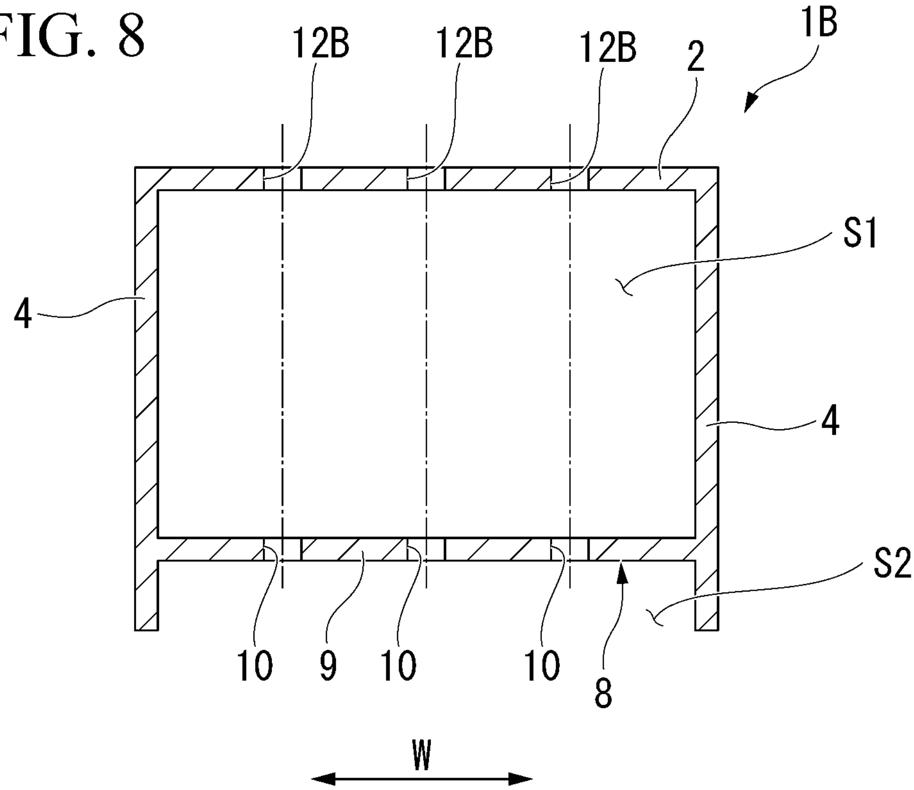

12B
12B
12B
2
1B
S1
4
4
S2
10
9
10
10
8
W

FIG. 9

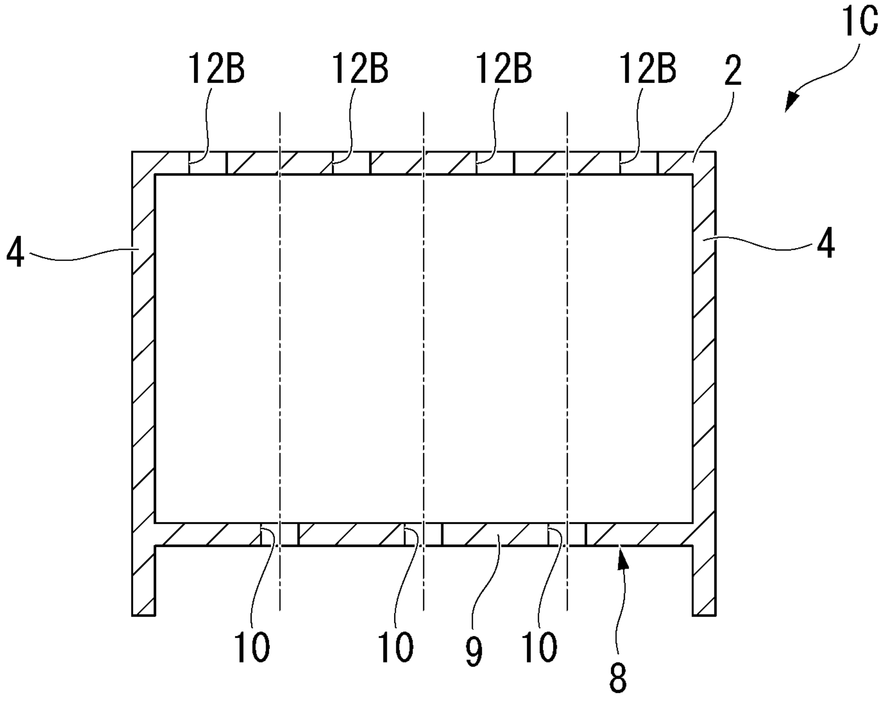

1C
12B
12B
12B
12B
2
4
4
10
10
9
10
8

FIG. 10

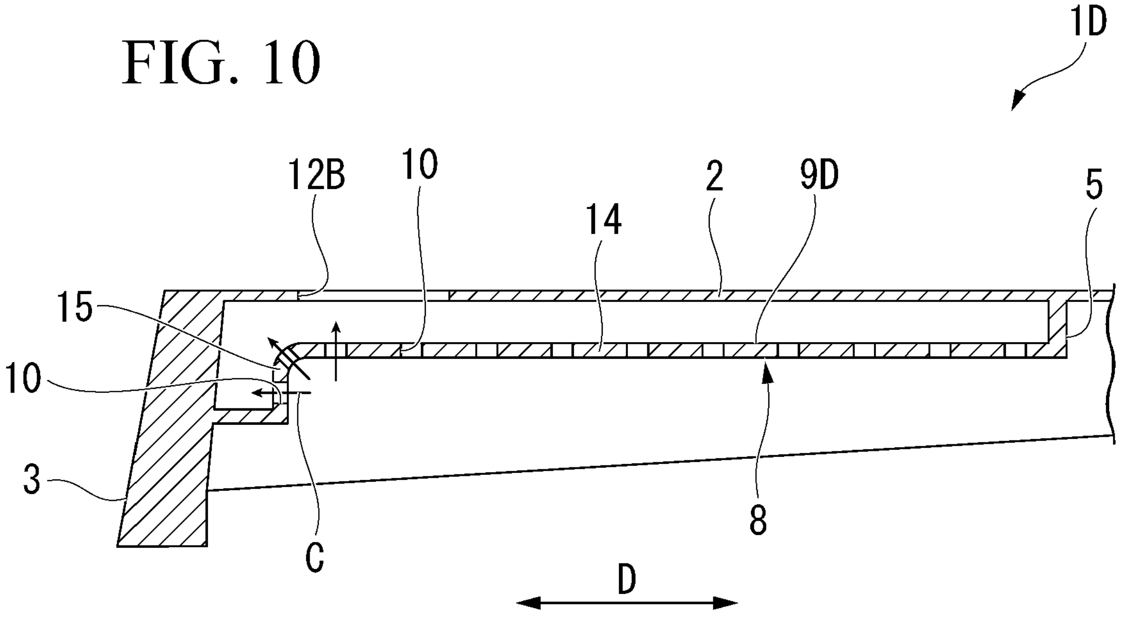


FIG. 11

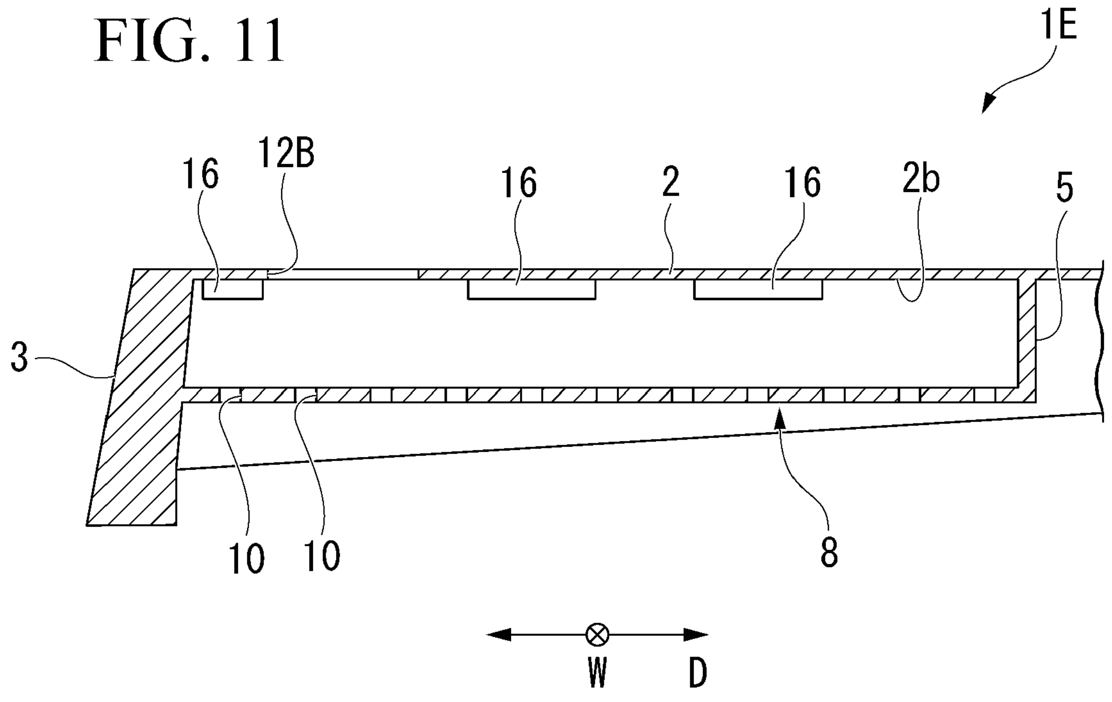


FIG. 12

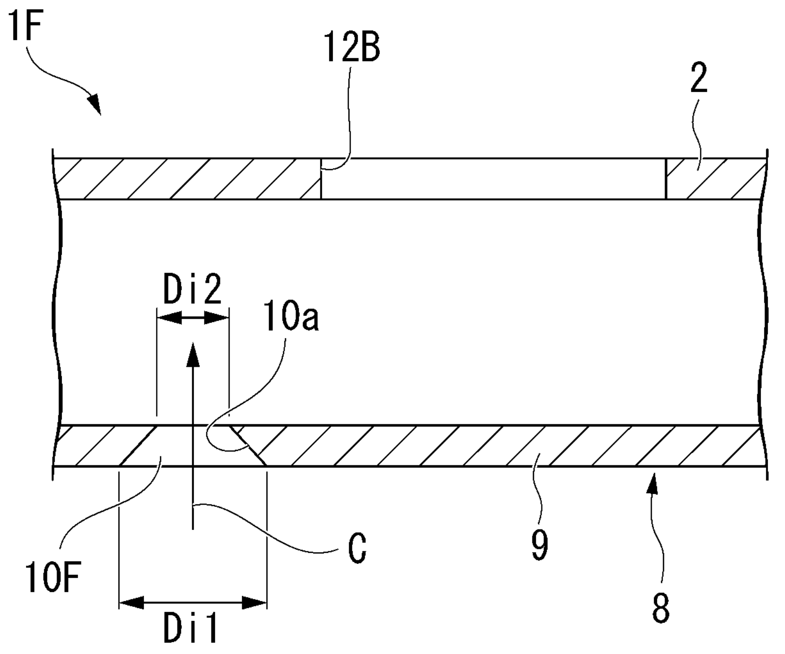

1F
12B
2
Di2
10a
10F
C
9
8
Di1

FIG. 13

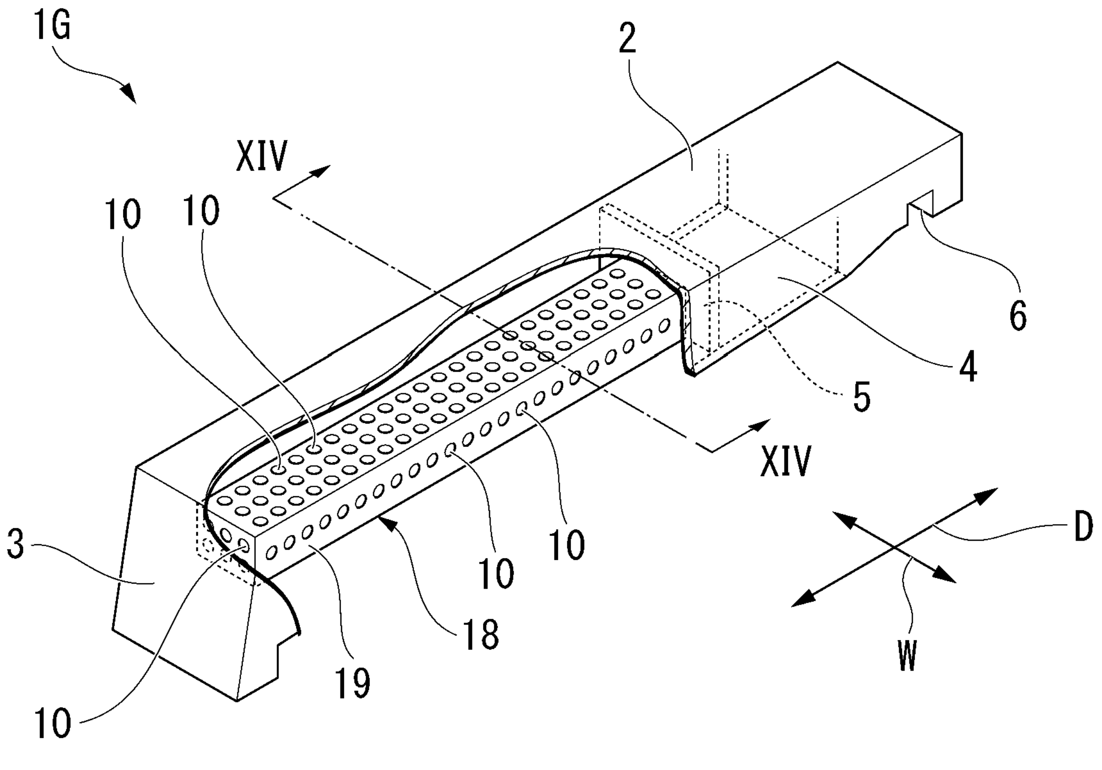

1G
2
XIV
10
10
6
4
5
XIV
3
10
10
18
19
10
D
W

FIG. 14

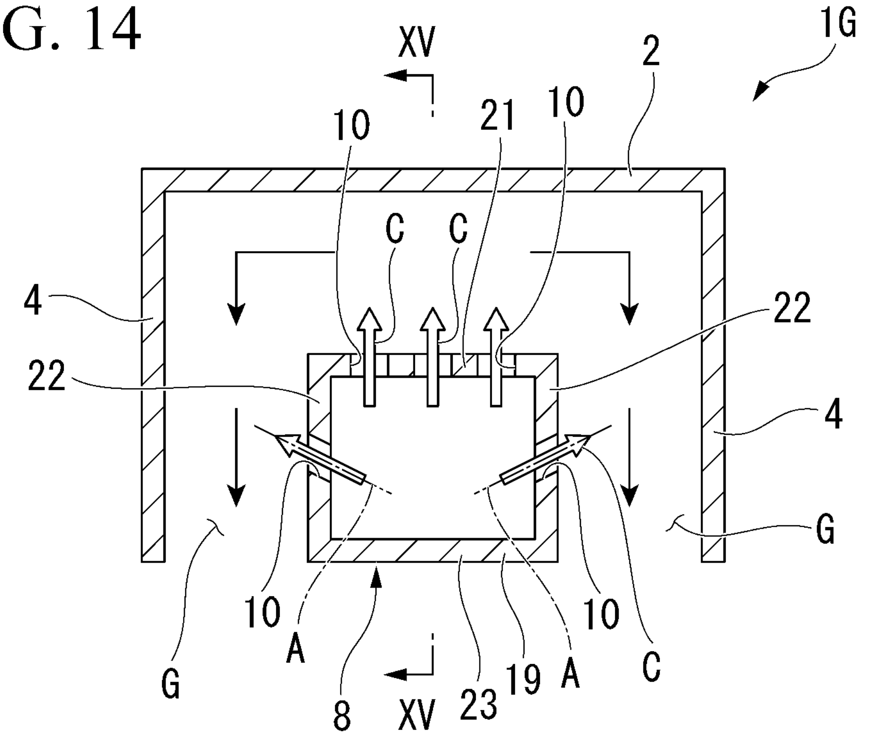
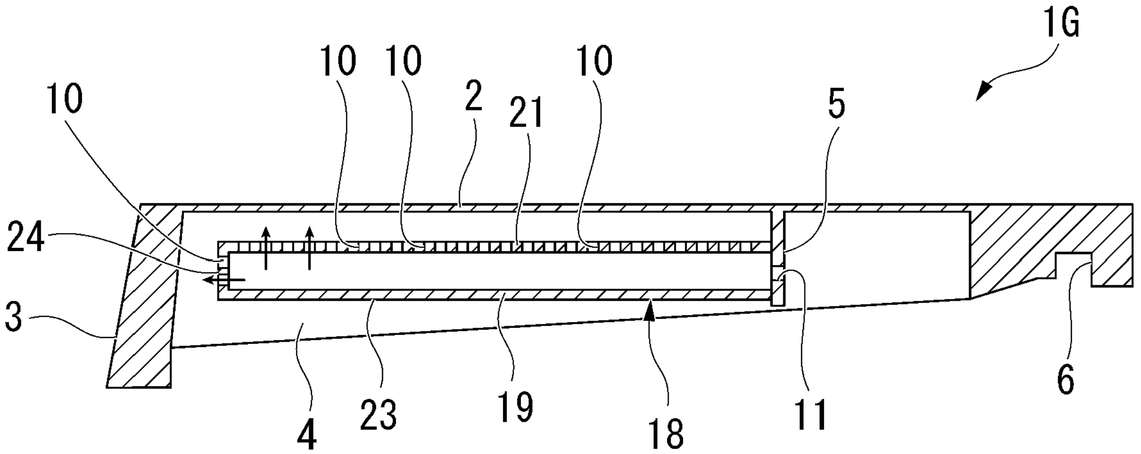

1G
XV
2
10
21
10
C
C
4
22
22
4
G
10
A
8
XV
23
19
A
10
C
G

FIG. 15


1G
10
10
10
2
21
10
5
24
3
4
23
19
18
11
6

REFERENCES CITED IN THE DESCRIPTION

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