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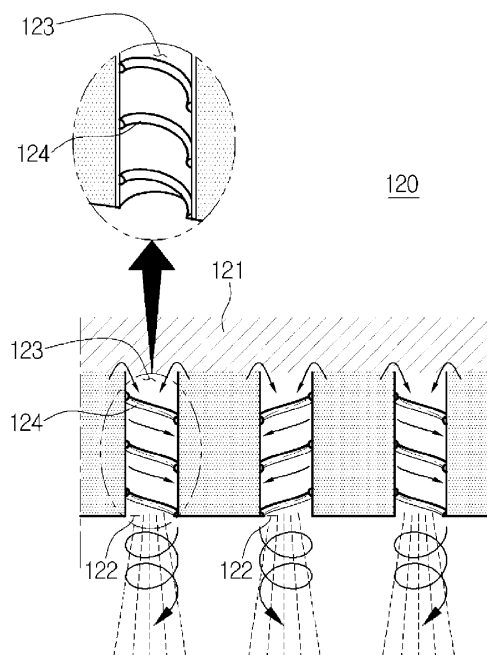
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(54) **Cooling system for thick plate or steel plate**

(57) Disclosed is a cooling system for a thick plate or a steel plate, which includes: a conveying unit conveying a cooling object; and a nozzle unit (120) disposed above the conveying unit and having a plurality of ejection holes (122) to eject cooling water supplied through a plurality of channels (123) formed therein to the cooling object, in which spiral swirl patterns are formed on the inner sides of the channels (123) such that cooling water comes in contact with the cooling object while spirally rotating and flowing from the nozzle unit (120).

Therefore, according to the cooling system for a thick plate or a steel plate of the present disclosure, it is possible to improve cooling performance and cooling efficiency by preventing cooling water from remaining on a cooling object such as a thick plate or a steel plate such that cooling water comes in direct contact with the cooling object such as a thick plate or a steel plate.

FIG. 3



Description

BACKGROUND OF THE INVENTION

(a) Field of the Invention

[0001] The present invention relates to a cooling system for a thick plate or a steel plate, and more particularly, to a cooling system for a thick plate or a steel plate which can improve cooling performance by minimizing remaining of cooling water on a thick plate or a steel plate.

(b) Description of the Related Art

[0002] A typical process of manufacturing steel is divided into: an iron-making process that injects ironstone, sintered ore, and cokes into a blast furnace, and makes molten iron by heating to melt the ironstone; a steel-making process that charges a rotating furnace with the molten iron, scrap iron, and sub-materials carried by a torpedo ladle car from a shaft furnace, and then removes impurities from the molten iron by blowing oxygen and makes desired components and molten steel at appropriate temperature by adding necessary components; a continuous molding process that directly manufactures a predetermined semi-finished product slab by injecting the molten steel produced in the steel-making process into a mold and continuously drawing the molten steel to be cooled; and a process that produces a product having a predetermined shape and predetermined dimensions with each hot rolling mill after carrying the semi-finished product produced by the continuous molding to a thick plate factory and reheating the semi-finished product therein, that is, a rolling process that makes various types of steel materials by heating the semi-finished product and then pushing the semi-finished product into between two rollers to compress the semi-finished product.

[0003] In particularly, in the rolling process, the semi-finished product is rolled to have a desired thickness in a rolling mill and then rapidly cooled to cooling temperature fitting the quality of the material of each standard while being conveyed by a roller table, such that the cooling process of a thick plate or a steel plate is considered as being very important.

[0004] FIG. 1 schematically shows an example of a cooling system for a thick plate or a steel plate of the related art.

[0005] However, as shown in FIG. 1, in a cooling system 10 for cooling a thick plate or a steel plate of the related art, some of the cooling water ejected from nozzles 12 remain on a cooling object S, such as a thick plate or a steel plate, and generate remaining water W, and the remaining water W interferes with direct contact between the cooling object S and the next ejected cooling water. In particular, cooling water starts remaining at the positions corresponding to the area where the nozzles 12 are not disposed, between the adjacent nozzles 12, and spreads to the region A corresponding to the area A

where the nozzles 12 are disposed.

[0006] That is, the cooling water ejected at the next time fails to directly contact to some areas of the cooling object S due to the remaining water W on the cooling object S and is inefficiently consumed, which causes a problem in that the entire cooling performance and cooling efficiency of the cooling system 10 are considerably decreased.

[0007] The above information disclosed in this Background section is only for enhancement of understanding of the background of the invention and therefore it may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

SUMMARY OF THE INVENTION

[0008] The present invention has been made in an effort to provide a cooling system for a thick plate or a steel plate having advantages of improving cooling performance and cooling efficiency by preventing cooling water from remaining on a cooling object such as a thick plate or a steel plate such that cooling water comes in direct contact with the cooling object such as a thick plate or a steel plate.

[0009] An exemplary embodiment of the present invention provides a cooling system for a thick plate or a steel plate, including: a conveying unit conveying a cooling object; and a nozzle unit disposed above the conveying unit and having a plurality of ejection holes to eject cooling water supplied through a plurality of channels formed therein to the cooling object, in which spiral swirl patterns are formed on the inner sides of the channels such that cooling water comes in contact with the cooling object while spirally rotating and flowing from the nozzle unit.

[0010] The plurality of ejection holes may have adjacent ejection holes that are disposed to be spaced apart from each other at regular intervals, and the swirl patterns may be formed in different directions such that the cooling water ejected from the adjacent ejection holes spirally flows in different directions.

[0011] The ejection holes may form an ejection module in which six ejection holes are arranged to be spaced apart from each other at the same angle at regular intervals around any one ejection hole.

[0012] The cooling system may further include a control unit controlling the ejection speed of the cooling water ejected from each ejection hole.

[0013] The swirl pattern may be formed in a screw thread shape protruding from the inner side of the channel.

[0014] The nozzle unit may have a casing with a space therein where the cooling water is received and the ejection holes may be open to the under side of the casing, and the ejection holes may be formed at the same surface as the underside of the casing.

[0015] The nozzle unit may have a casing with a space

therein where the cooling water is received and the ejection holes may be open to the underside of the casing, and the ejection holes may extend and protrude downward from the underside of the casing.

[0016] According to an exemplary embodiment of the present invention, it is possible to prevent cooling water from remaining on a thick plate or a steel plate that is a cooling object in cooling.

[0017] According to an exemplary embodiment of the present invention, it is possible to improve the contact performance between the ejected cooling water and the cooling object by forcibly removing the cooling water that has remained.

[0018] According to an exemplary embodiment of the present invention, it is possible to preclude generation of remaining water and easily remove the water that has remained, by improving momentum due to the flow of cooling water, by forming the spiral swirl patterns.

[0019] According to an exemplary embodiment of the present invention, it is possible to improve the effect of suppressing the remaining water and prevent excessive consumption of the cooling water by adjusting the pitches of the swirl patterns.

[0020] According to an exemplary embodiment of the present invention, it is possible to improve the effect of suppressing the remaining water and prevent excessive consumption of the cooling water by adjusting the flow rate of the cooling water for each ejection hole with the control unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

FIG. 1 schematically shows an example of a cooling system for a thick plate or a steel plate of the related art.

FIG. 2 is a schematic perspective view of a cooling system for a thick plate or a steel plate according to an exemplary embodiment of the present invention.

FIG. 3 is a schematic internal cross-sectional view of nozzles of the cooling system for a thick plate or a steel plate shown in FIG. 2, taken along line III - III'. FIG. 4 is a schematic view of a nozzle unit for illustrating the arrangement of nozzle holes of the cooling system for a thick plate or a steel plate shown in FIG. 2.

FIG. 5 is a schematic view for illustrating the principle of removing remaining water from a cooling object by operating the cooling system for a thick plate or a steel plate shown in FIG. 2.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0022] Hereinafter, an exemplary embodiment of the present invention will be described with reference to the accompanying drawings for those skilled in the art to easily implement the present invention. As those skilled in

the art would realize, the described embodiments may be modified in various different ways, all without departing from the spirit or scope of the present invention. The drawings and description are to be regarded as illustrative in nature and not restrictive. Like reference numerals designate like elements throughout the specification.

[0023] FIG. 2 is a schematic perspective view of a cooling system for a thick plate or a steel plate according to an exemplary embodiment of the present invention.

[0024] Referring to FIG. 2, a cooling system 100 for a thick plate or a steel plate according to an exemplary embodiment of the present invention, a cooling system that implements improved cooling efficiency by preventing cooling water from remaining on a thick plate of a steel plate that is a cooling object in cooling, includes a conveying unit 110, a nozzle unit 120, and a control unit 130

[0025] The conveying unit 110 is a conveying module for conveying a cooling object S such as a thick plate or a steel plate and is implemented by a roller table in the present exemplary embodiment, but is not limited thereto and may be designed in various types generally in consideration of the weight, material, and the like of the cooling object.

[0026] FIG. 3 is a schematic internal cross-sectional view of nozzles of the cooling system for a thick plate or a steel plate shown in FIG. 2, taken along line III - III' and FIG. 4 is a schematic view of a nozzle unit for illustrating the arrangement of nozzle holes of the cooling system for a thick plate or a steel plate shown in FIG. 2.

[0027] Referring to FIGS. 3 and 4, the nozzle unit 120 is disposed above the conveying unit 110 described above and ejects cooling water to the cooling object S that is being conveyed thereunder, and is configured to have a plurality of ejection holes 122 at the underside of a casing 121

[0028] The casing 121 is a hexagonal box shape member defining a space therein for receiving cooling water therein and formed to be long in the width direction of the cooling object.

[0029] Meanwhile, a plurality of ejection holes 122 is formed at the underside of the casing 121, and the ejection holes 122 each have a circular cross-section in the present exemplary embodiment, but are not limited thereto. The shape of the cross-sections of the ejection holes 122 may be determined in consideration of the material of an ejection object, the conveying speed of the ejection object, and the surface temperature of a heated ejection object.

[0030] Further, although the ejection holes 122 are formed through the same surface as the underside of the casing 121 in the present exemplary embodiment, they are not limited thereto and may extend and protrude downward from the casing 121 in a modified example.

[0031] Meanwhile, according to the arrangement structure of the ejection holes 122 in the present exemplary embodiment, the ejection holes 122 are formed to be spaced apart from each other at regular intervals in

the longitudinal direction of the casing 121. The ejection holes 122 are disposed to be spaced apart from each other at regular intervals in the orthogonal direction with respect to the width direction of the casing 121. That is, the ejection holes 122 are disposed at predetermined distances in the width direction of the casing from the centers of the ejection holes 122 that are adjacent in the longitudinal direction of the casing 121.

[0032] Describing the arrangement of the ejection holes 122 again, a virtual ejection module M is composed of a total of seven ejection holes 122 and each ejection module M has a structure in which six ejection holes 122 are circumferentially disposed at regular angles and regular intervals I around the ejection hole 122 at the center. That is, in any one ejection module M, the ejection holes 122 are disposed at the apexes and the center of a regular hexagon, respectively.

[0033] Further, the ejection module M is not fixed and a virtual ejection module M may be formed around one ejection hole that is freely selected.

[0034] Channels 123 for supplying cooling water to the ejection hole 122 as passages through which the cooling water flows are formed in the casing 121 connected with the ejection holes 122. A spiral swirl pattern 124 is formed on the inner side of the channel 123 such that cooling water flowing therein is guided to spirally rotate and flow.

[0035] The shape and the structure of the swirl pattern 124 are not limited as long as it can guide the spiral flow of the cooling water and the swirl pattern 124 of the present exemplary embodiment is formed in a screw thread shape protruding from the inner side of the channel 123. Further, the distance between the screw threads of the spiral swirl pattern 124, that is, the pitch determines the rotation speed of the cooling water, such that the pitch of the swirl pattern 124 may be determined in consideration of the rotation speed of the cooling water when being ejected from the ejection holes 122.

[0036] Further, the spiral swirl patterns 124 are formed in different directions in the channels 123 connected to the ejection holes 122 adjacent to the ejection holes 122 forming the hexagon of the virtual ejection module M described above, such that the cooling water ejected from the adjacent ejection holes 122 is discharged while rotating in different directions. That is, when a right thread shape of swirl pattern is formed in the channel 123 formed at one ejection hole, a left thread shape of swirl pattern may be formed in the channel connected to an adjacent ejection hole.

[0037] The control unit 130 is provided for controlling the flow rate of the cooling water ejected from the ejection holes 122, that is, the ejection speed for each ejection hole 122, and may be electrically connected with the ejection holes 122.

[0038] The operation of an exemplary embodiment of the cooling system 100 for a thick plate or a steel plate described above will be described hereinafter.

[0039] FIG. 5 is a schematic view for illustrating the principle of removing remaining water from a cooling ob-

ject by operating the cooling system for a thick plate or a steel plate shown in FIG. 2.

[0040] First, the cooling system 100 for a thick plate or a steel plate of the present exemplary embodiment is installed behind a rolling process, and when a cooling object S heated by the rolling process is continuously conveyed by the conveying unit 110, cooling water is ejected downward from the ejection holes 122 of the nozzle unit 120, thereby cooling the cooling object S such as a thick plate or a steel plate.

[0041] In this process, the cooling water flows in the channels 123 before ejected from the ejection holes 122 and the cooling water in the channels 123 flows while spirally rotating along the spiral swirl patterns 124 formed on the inner sides of the channels 123. Therefore, the cooling water flows with spiral rotation by the swirl patterns 124 is discharged from the ejection holes 122 while keeping the rotational flow, and comes in contact with the upper surface of the cooling object S such as a thick plate or a steel plate, thereby performing a cooling process.

[0042] Meanwhile, as shown in FIG. 5, describing the rotational flow of the cooling water ejected from the ejection holes 122 for each ejection module M, since the spiral swirl patterns 124 are formed in different directions on the inner sides of the channels 123 connected to the adjacent ejection holes 122 of the ejection holes 122 at the apexes of the regular hexagon of the ejection module M, the cooling water ejected from the adjacent ejection holes 122 is discharged while flowing in different rotational directions.

[0043] As the cooling water flowing in different rotational directions reaches the upper surface of a thick plate or a steel plate that is the cooling object S, the cooling process can be performed. Accordingly, it is possible to prevent the cooling water from remaining on the upper surface of the cooling object S by the rotational flow and the cooling water that has remained on the upper surface of the cooling object S is removed from the cooling object S by an increase in momentum due to the rotational flow of the cooling water.

[0044] Further, the control unit 130 can adjust the effect of removing the remaining water for each position of the cooling object S by controlling the flow rate of the cooling water, that is, the ejection speed for each ejection hole 122.

[0045] That is, the control unit 130 can selectively adjust the ejection speed, depending on the amount of cooling water remaining at each position of the cooling object S.

[0046] Further, the control unit 130 may control the ejection speed for each ejection module M that is freely divided and selected.

[0047] Therefore, the cooling system 100 for a thick plate or a steel plate of the present exemplary embodiment allows the cooling water to separate from the cooling object S right after cooling, by making the cooling water flows with rotation on the upper surface of the cool-

ing object S in the cooling process. Therefore, it is possible to preclude generation of remaining water and improve the entire cooling efficiency.

[0048] Further, it is possible to improve the cooling efficiency by inducing the cooling water ejected at the next time to come in direct contact with the cooling object S, by removing the remaining water generated when the cooling water ejected first in the cooling process is not removed and remains after reaching the cooling object S.

[0049] The scope of the present invention is not limited to the exemplary embodiment and may be achieved in various ways within the accompanying claims. Various ranges where those skilled in the art can modify the present invention without departing from the spirit of the present invention claimed in the claims are construed as being included in the range described in the claims of the present invention.

<Description of symbols>

[0050]

- 100 : Cooling system for a thick plate or steel plate
 110 : Conveying unit
 130 : Control unit
 120 : Nozzle unit

Claims

1. A cooling system for a thick plate or a steel plate, comprising:

a conveying unit conveying a cooling object; and
 a nozzle unit disposed above the conveying unit and having a plurality of ejection holes to eject cooling water supplied through a plurality of channels formed therein to the cooling object,

wherein spiral swirl patterns are formed on the inner sides of the channels such that cooling water comes in contact with the cooling object while spirally rotating and flowing from the nozzle unit.

2. The cooling system of claim 1, wherein:

the plurality of ejection holes have adjacent ejection holes that are disposed to be spaced apart from each other at regular intervals, and
 the swirl patterns are formed in different directions such that the cooling water ejected from the adjacent ejection holes spirally flows in different directions.

3. The cooling system of claim 1 or 2, wherein:

the ejection holes forms an ejection module in which six ejection holes are arranged to be

spaced apart from each other at the same angle at regular intervals around any one ejection hole.

4. The cooling system of any one of claims 1 to 3, further comprising:

a control unit controlling the ejection speed of the cooling water ejected from each ejection hole.

5. The cooling system of any one of claims 1 to 4, wherein:

the swirl pattern is formed in a screw thread shape protruding from the inner side of the channel.

6. The cooling system of any one of claims 1 to 5, wherein:

the nozzle unit has a casing with a space therein where the cooling water is received and the ejection holes are open to the underside of the casing, and
 the ejection holes are formed at the same surface as the underside of the casing.

7. The cooling system of any one of claims 1 to 5, wherein:

the nozzle unit has a casing with a space therein where the cooling water is received and the ejection holes are open to the under side of the casing, and,
 the ejection holes extend and protrude downward from the underside of the casing.

FIG. 1

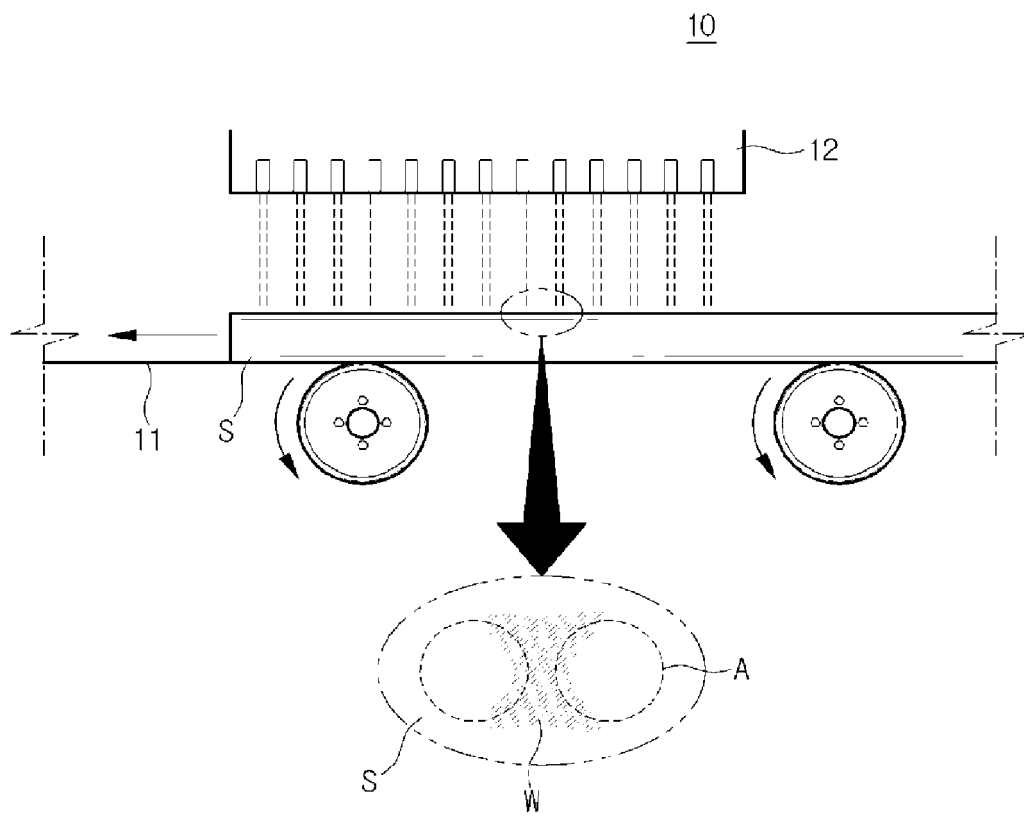


FIG. 2

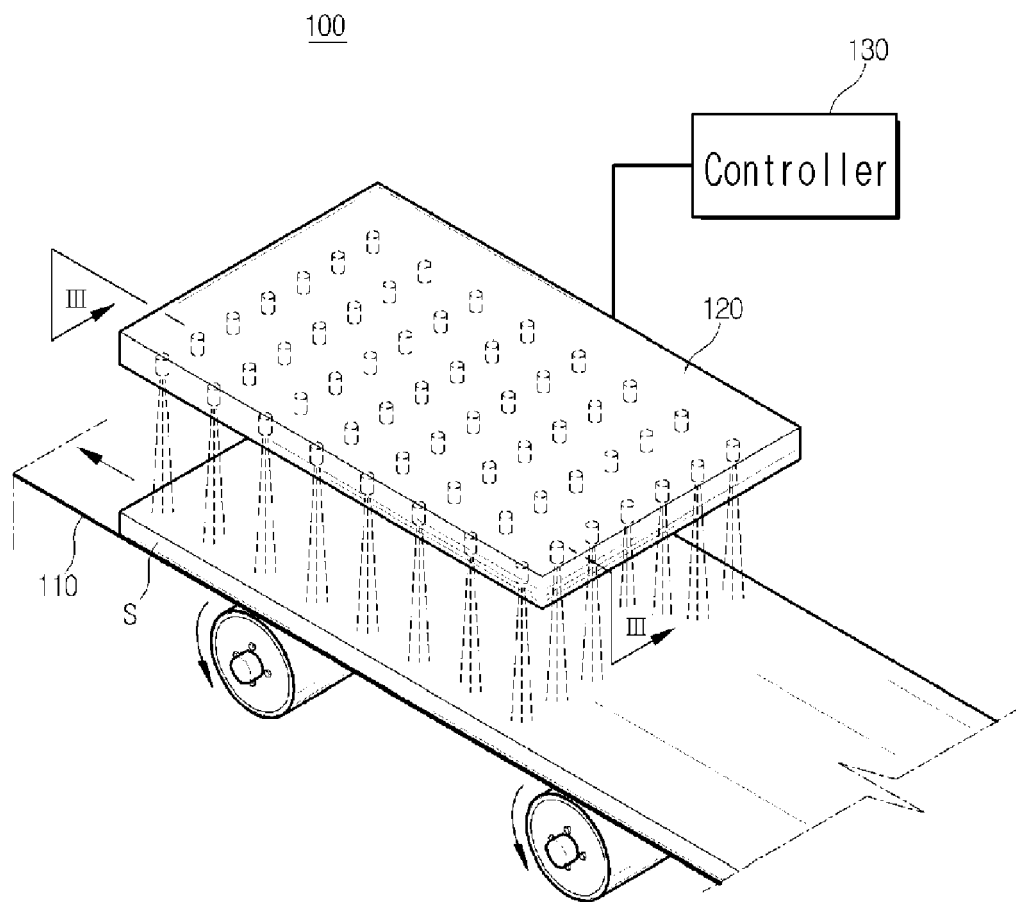


FIG. 3

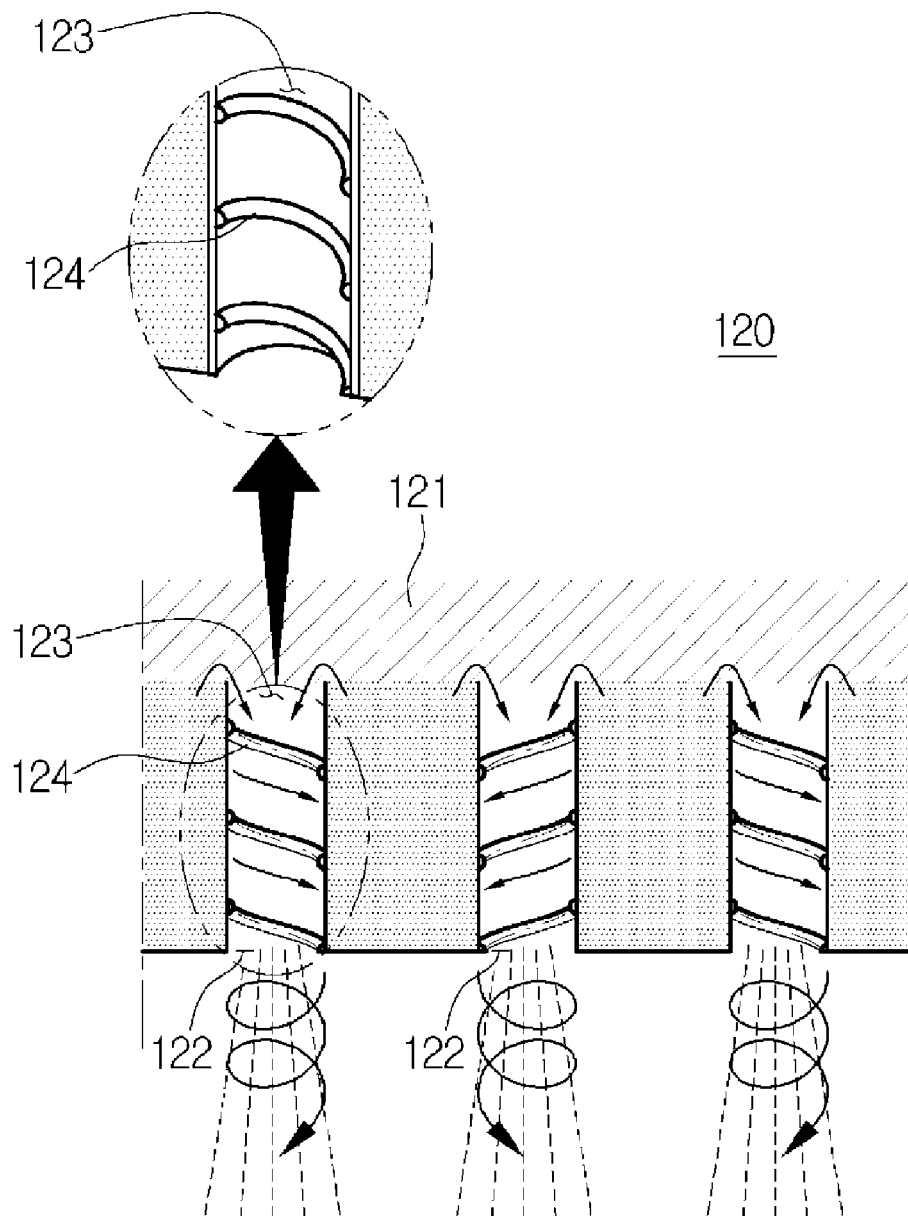


FIG. 4

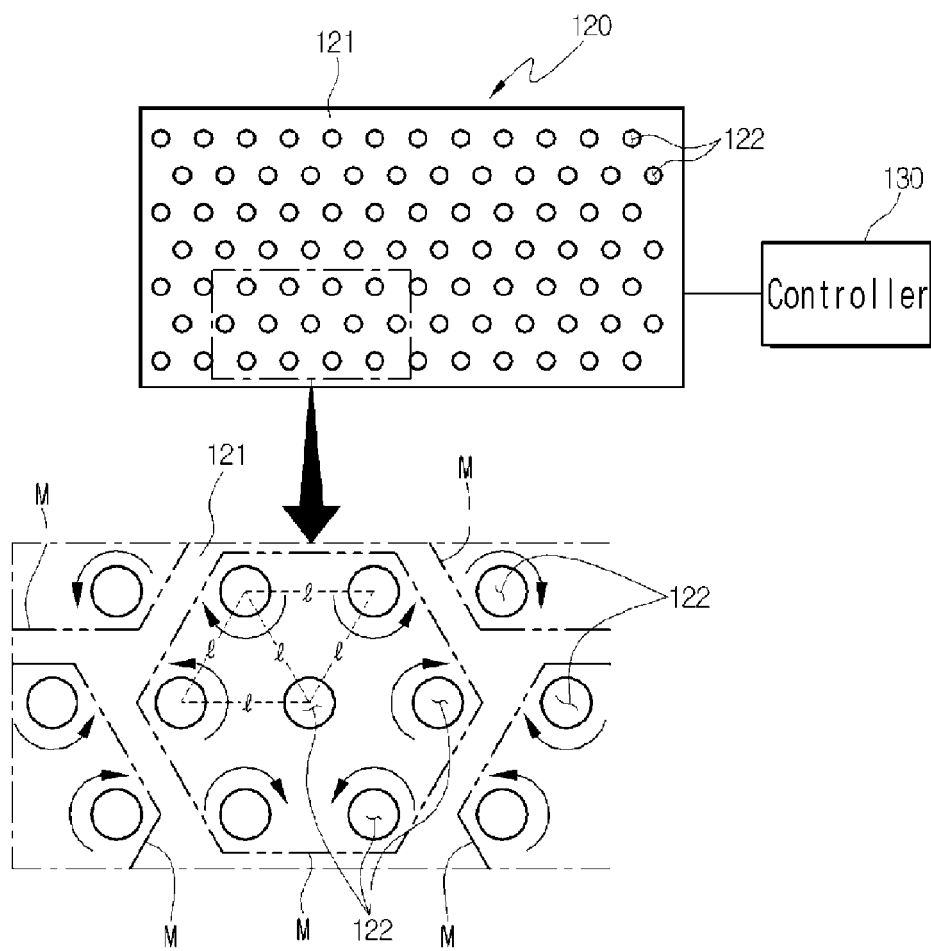
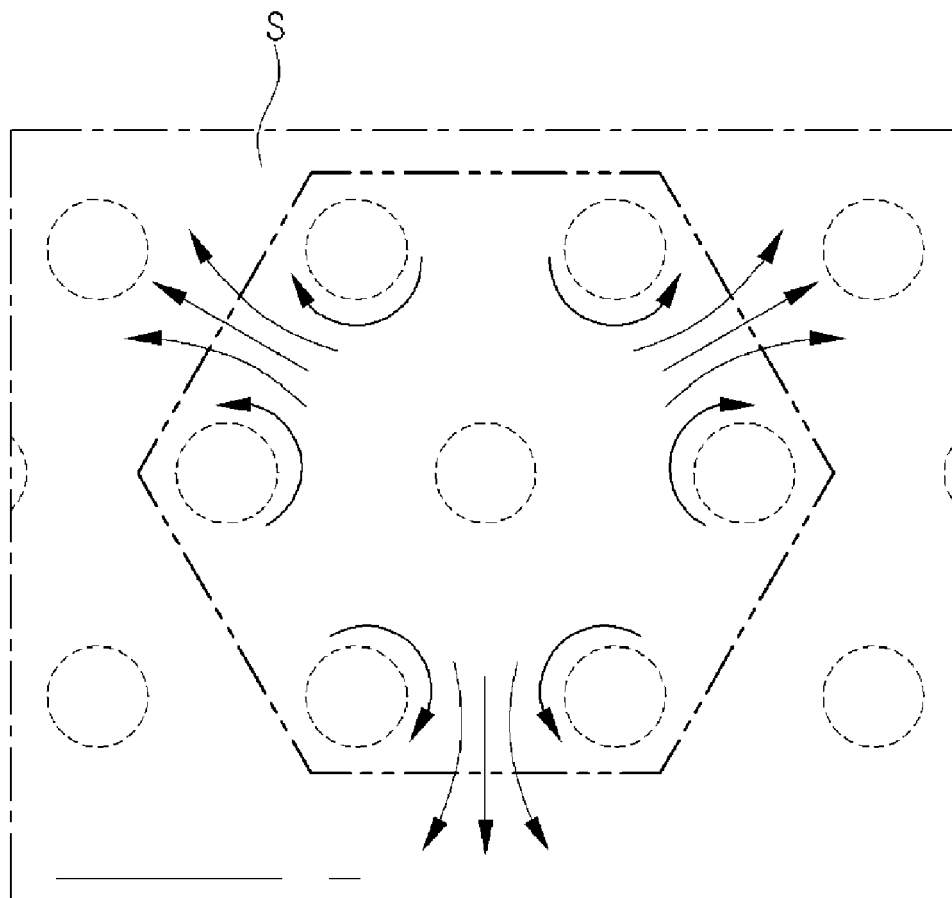


FIG. 5





EUROPEAN SEARCH REPORT

Application Number
EP 12 17 3837

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 6 May 2013	Examiner Forciniti, Marco
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 12 17 3837

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The members are as contained in the European Patent Office EDP file on
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