



US 20140047886A1

(19) **United States**(12) **Patent Application Publication**
Park et al.(10) **Pub. No.: US 2014/0047886 A1**(43) **Pub. Date: Feb. 20, 2014**(54) **STEAM-BLOCKING APPARATUS****Publication Classification**(71) Applicant: **Hyundai Steel Company**, Incheon (KR)(72) Inventors: **Yong Kook Park**, Anyang (KR); **Jong Hyob Lim**, Seoul (KR); **Hyeong Jin Kim**, Jeonju (KR); **Ho Jin Nam**, Dangjin-Gun (KR); **Jin Uk Shin**, Asan (KR); **Kwan Hyung Lee**, Suwon (KR); **Hyun Jun Choi**, Asan (KR)(51) **Int. Cl.****B21B 45/08** (2006.01)**B21B 37/76** (2006.01)(52) **U.S. Cl.**CPC **B21B 45/08** (2013.01); **B21B 37/76** (2013.01)USPC **72/39**(73) Assignee: **Hyundai Steel Company**, Incheon (KR)(21) Appl. No.: **14/065,249**(22) Filed: **Oct. 28, 2013****Related U.S. Application Data**

(63) Continuation of application No. PCT/KR2011/010011, filed on Dec. 22, 2011.

(30) **Foreign Application Priority Data**

Apr. 27, 2011 (KR) 10-2011-0039422

May 30, 2011 (KR) 10-2011-0051144

(57) **ABSTRACT**

A steam-blocking apparatus includes: a rolling mill configured to roll a material; a transfer roller disposed at a rear side of the rolling mill and configured to transfer the material from the rolling mill; a descaler disposed above the transfer roller and configured to spray wash water toward the transfer roller; a width-measuring part disposed at a rear side of the descaler and configured to measure the width of the material; and a shield disposed between the descaler and the width-measuring part and configured to prevent steam, generated from evaporation of the wash water, from being introduced into the width-measuring part.

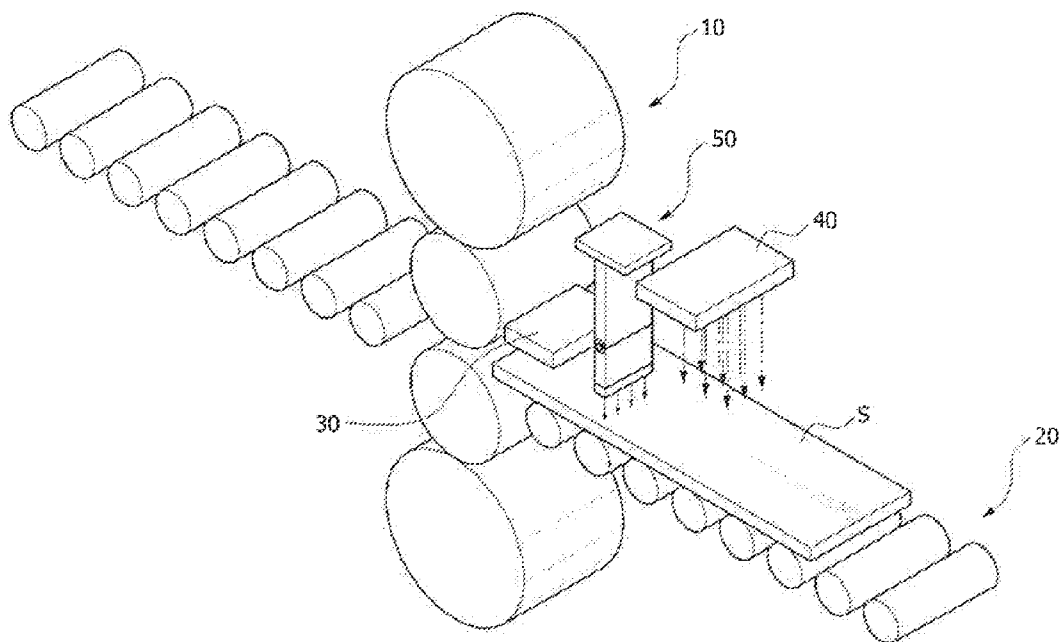


FIG.1

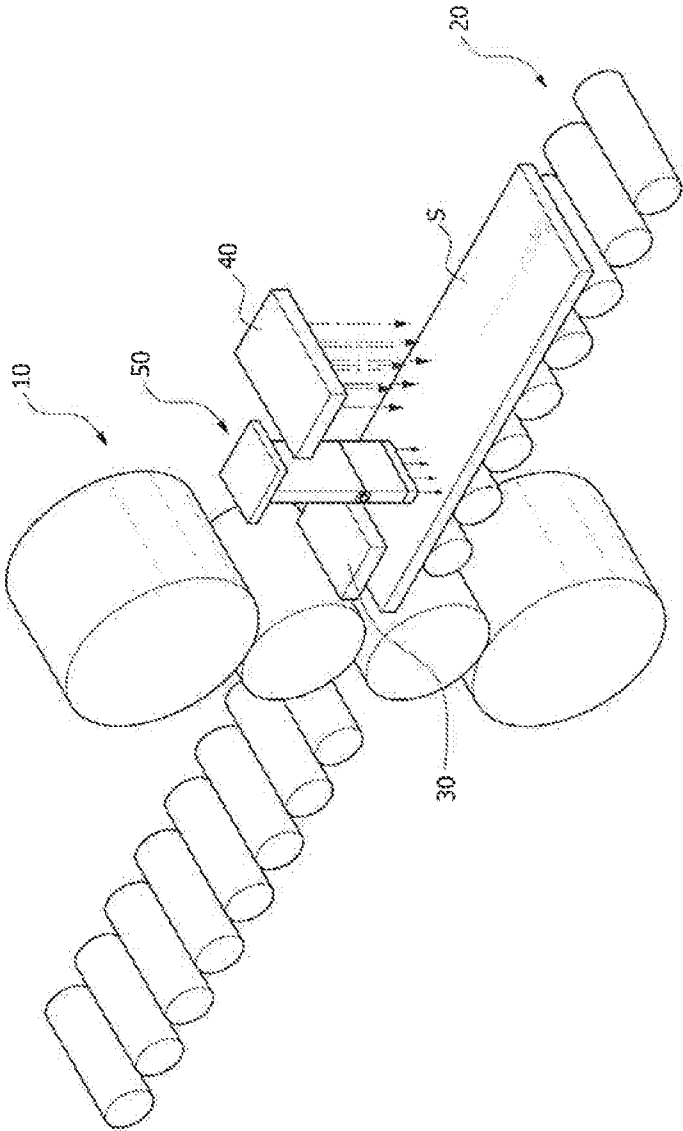


FIG.2

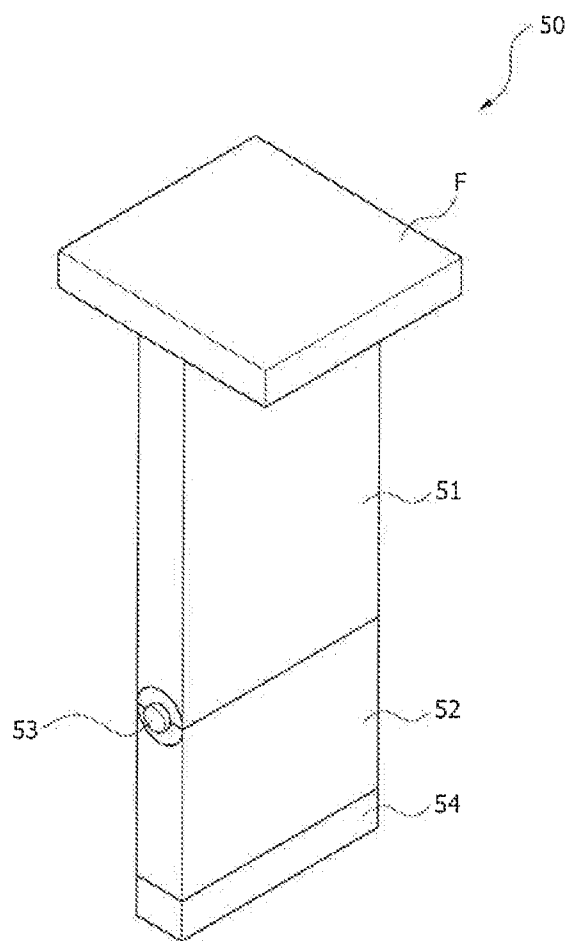


FIG.3

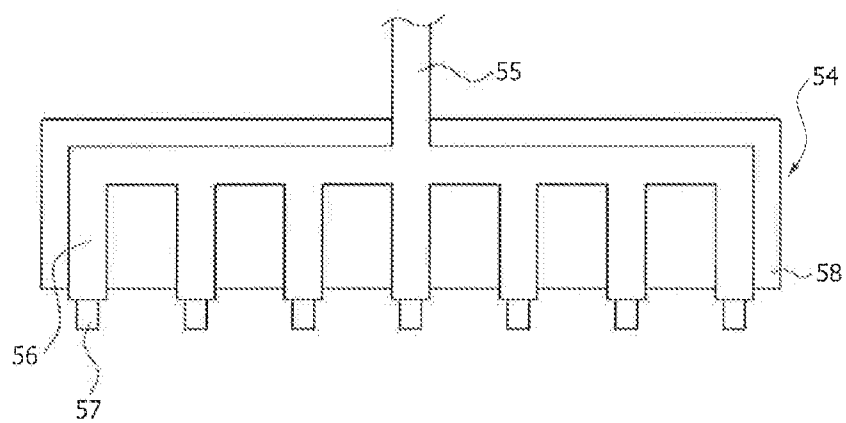


FIG.4

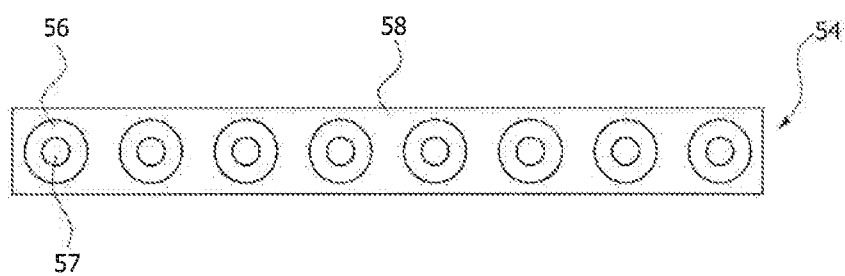


FIG.5

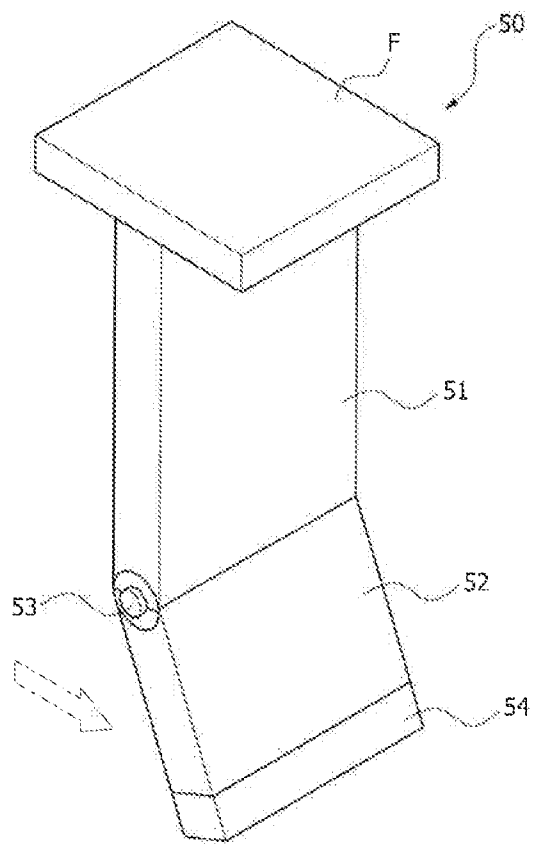


FIG.6

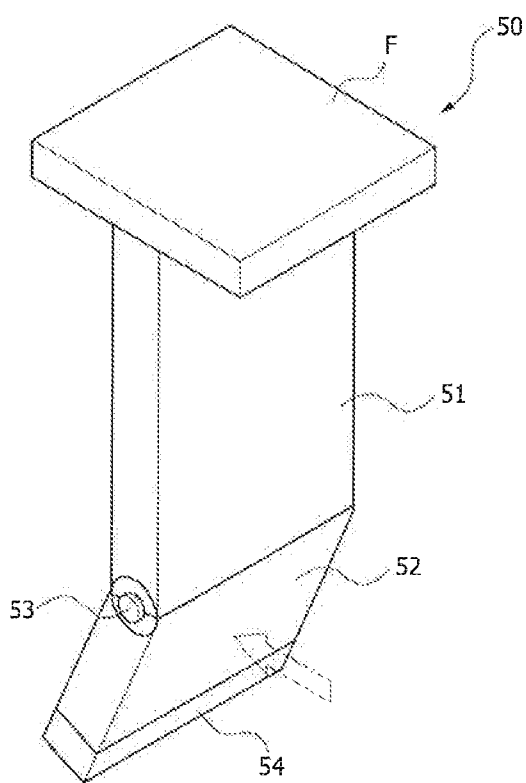


FIG.8

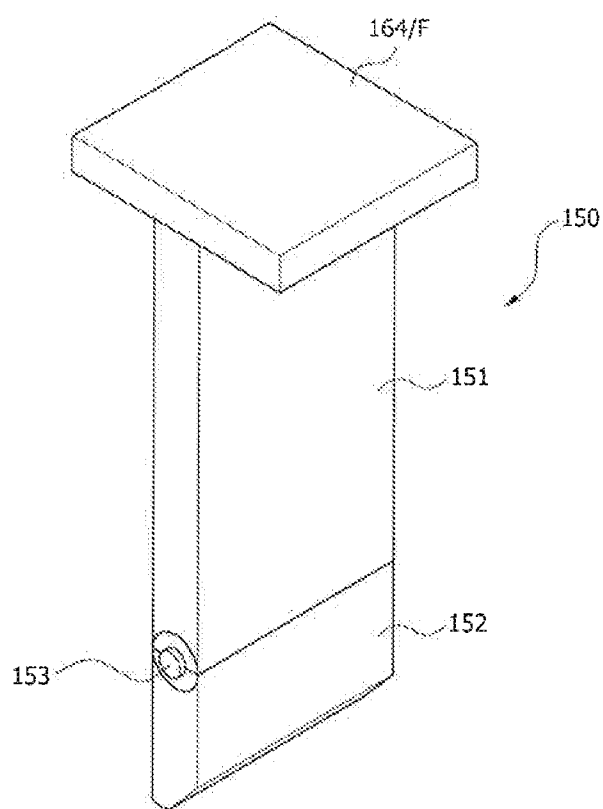


FIG.9

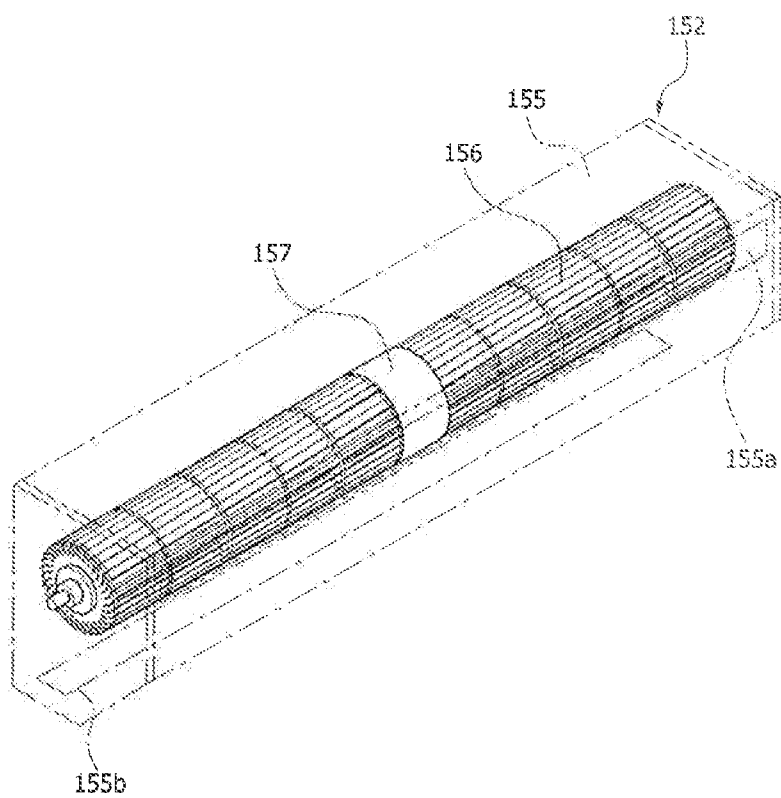


FIG.10

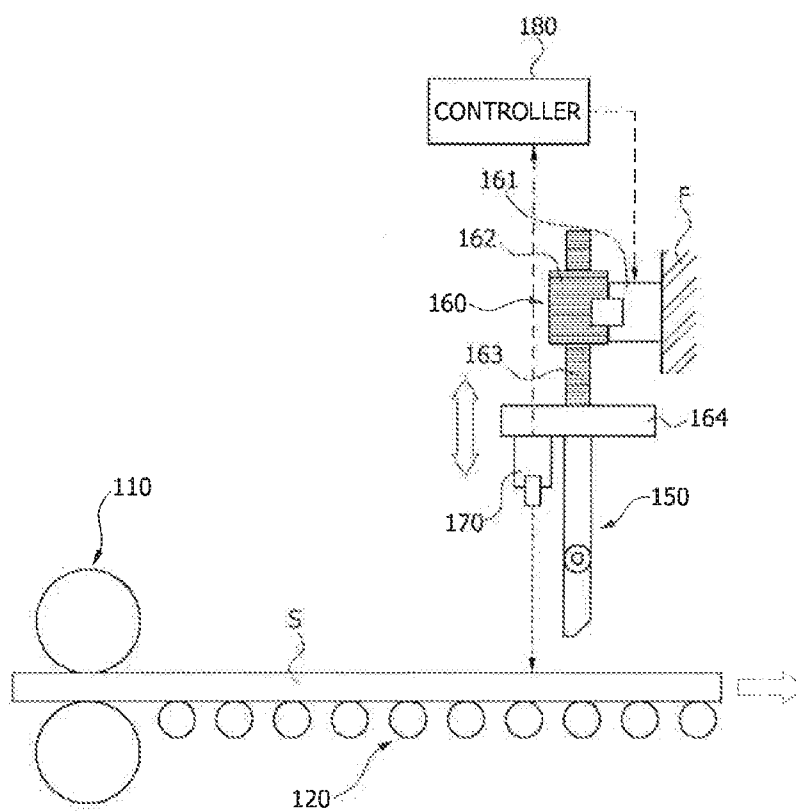


FIG.11

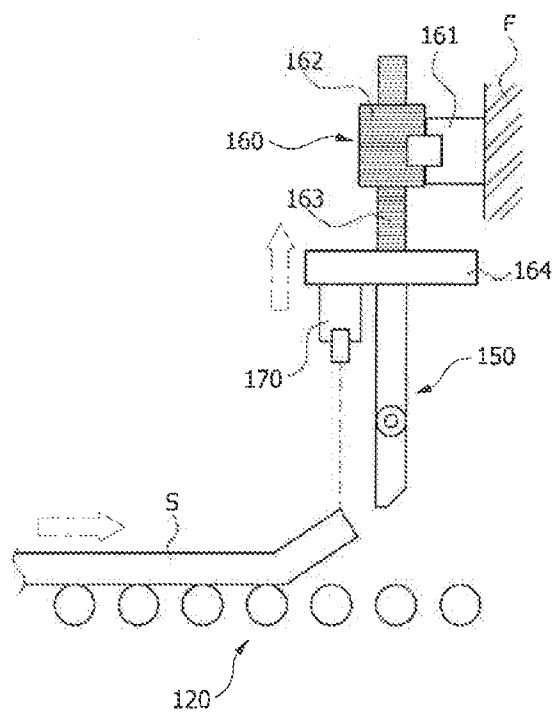


FIG.12

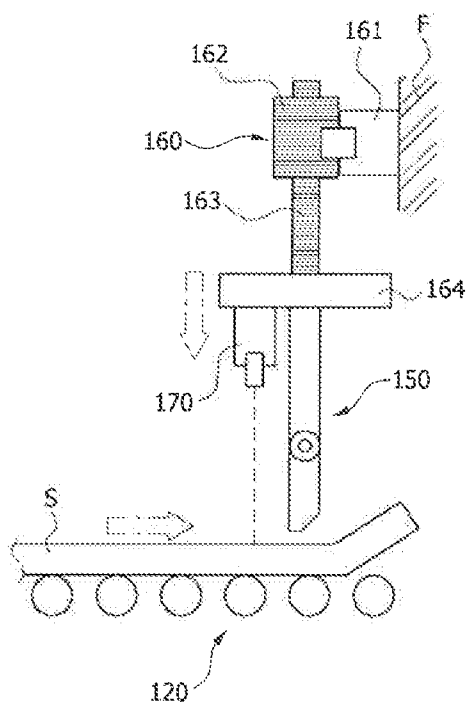


FIG.13

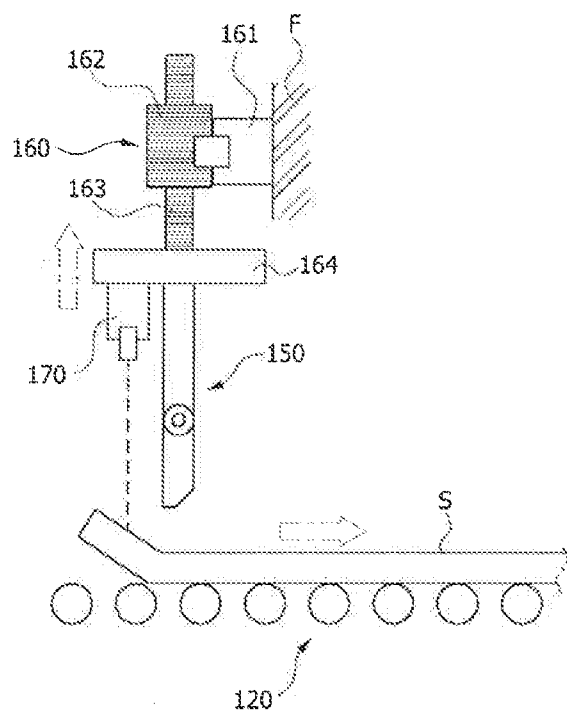


FIG.14

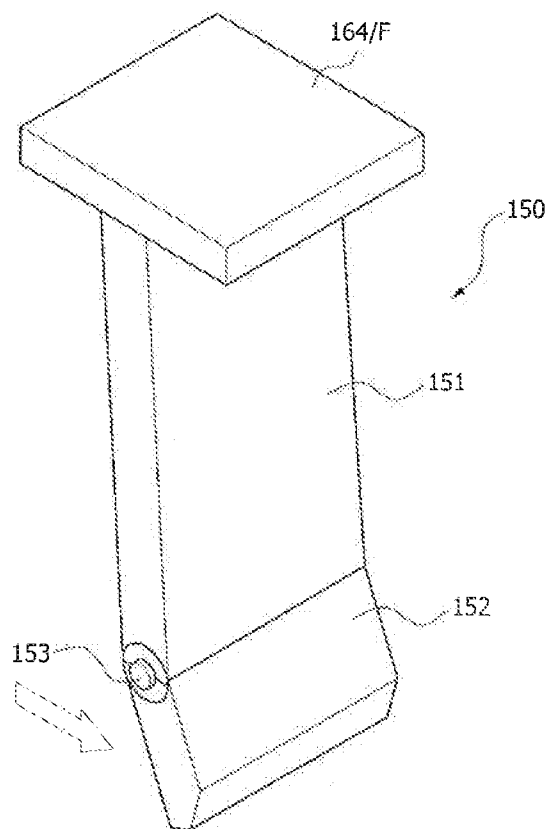


FIG.15

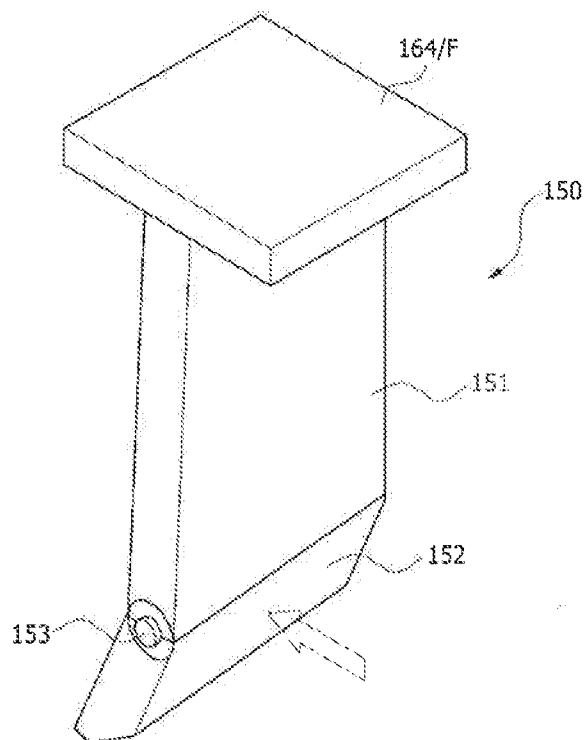


FIG.16

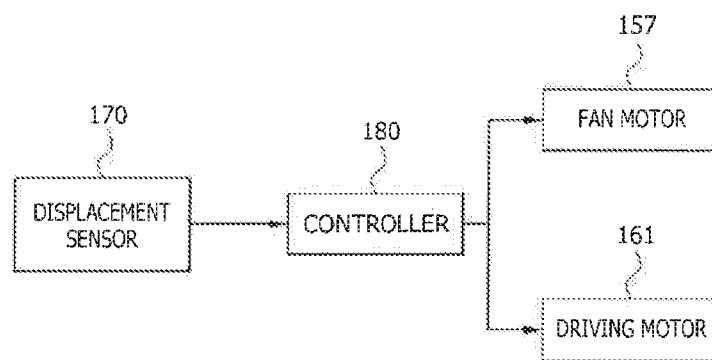


FIG.17

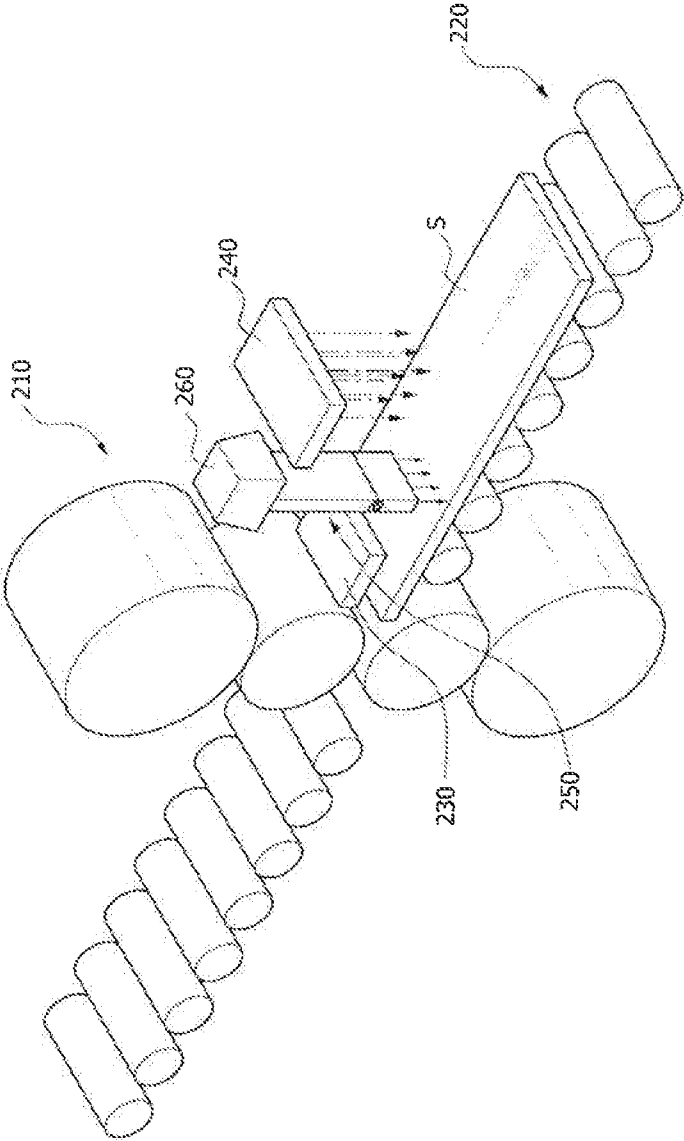


FIG.18

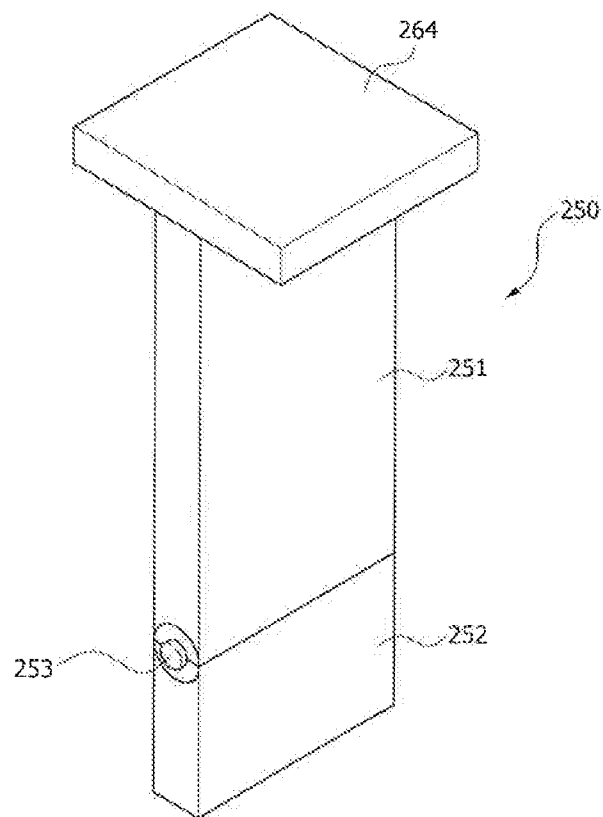


FIG.19

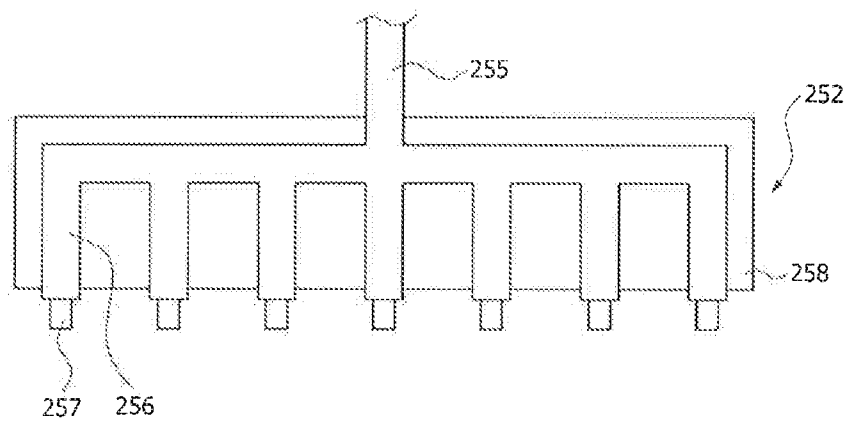


FIG.20

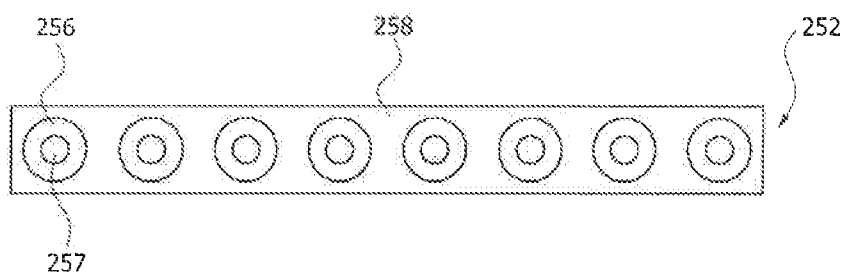


FIG.21

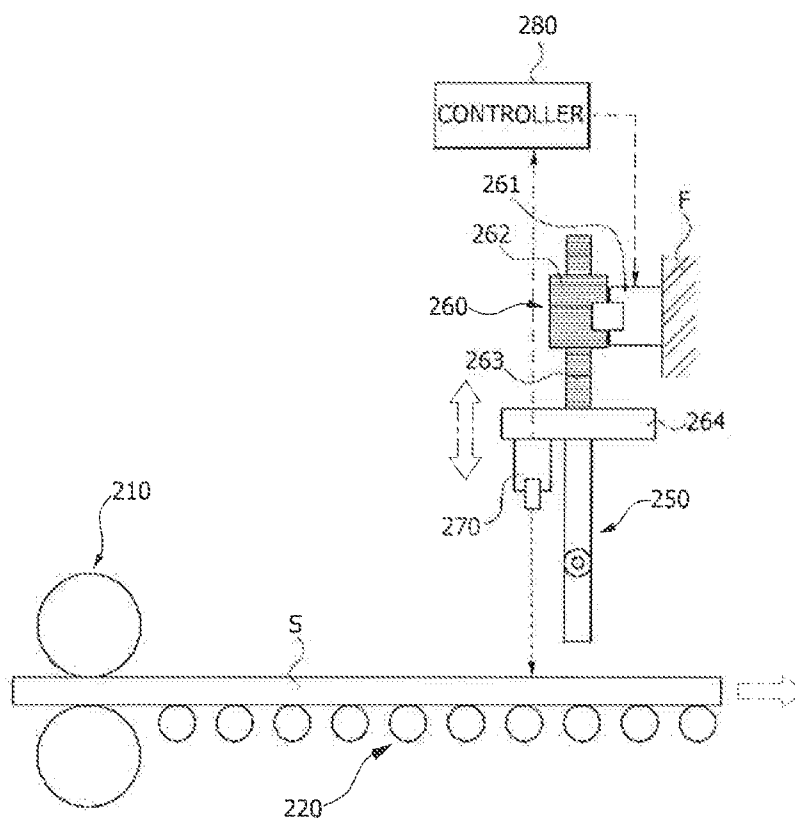


FIG.22

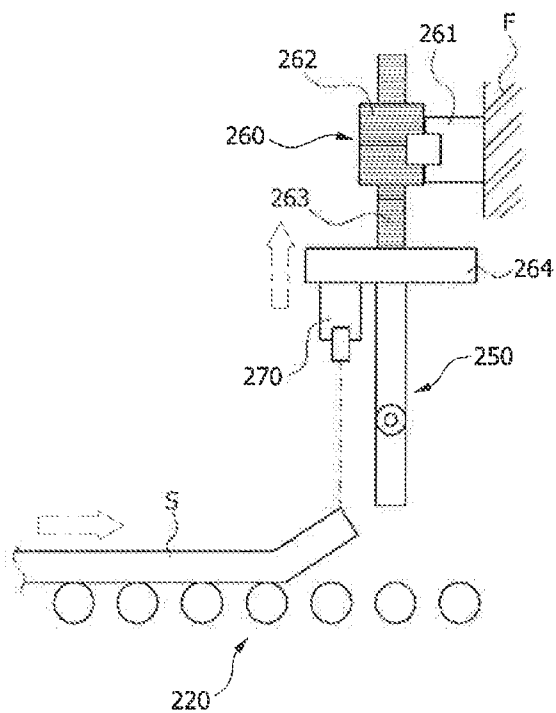


FIG.23

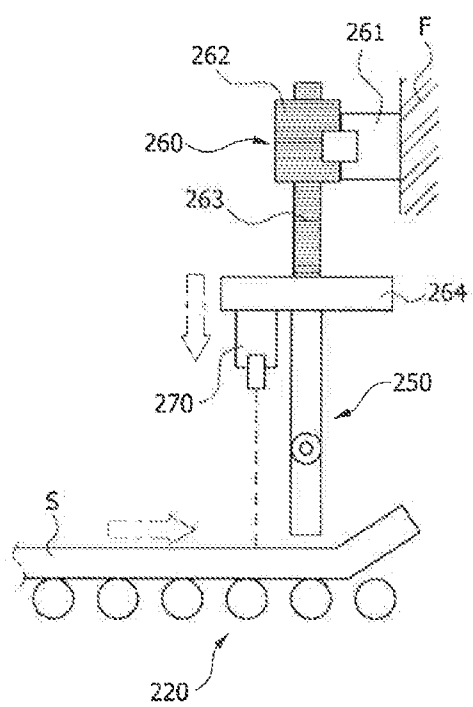


FIG.24

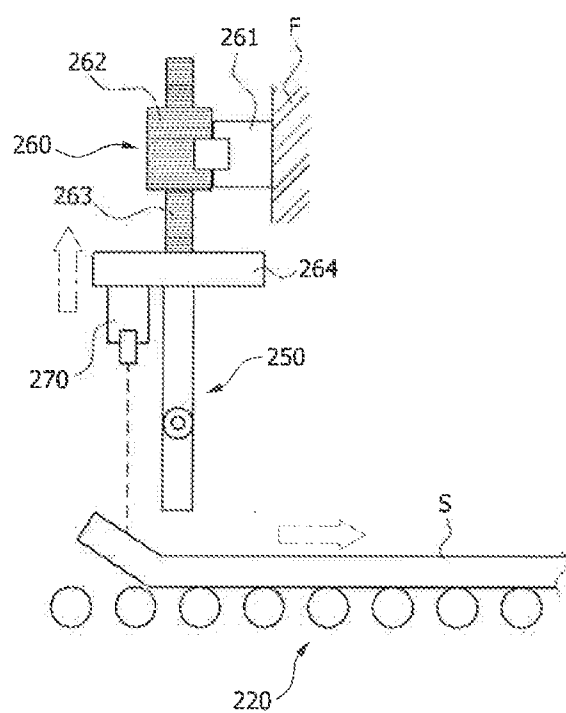


FIG.25

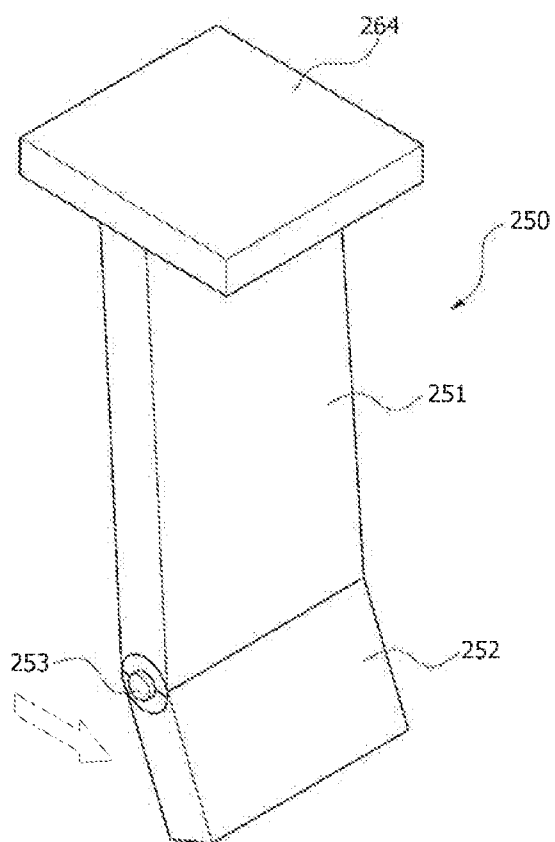


FIG.26

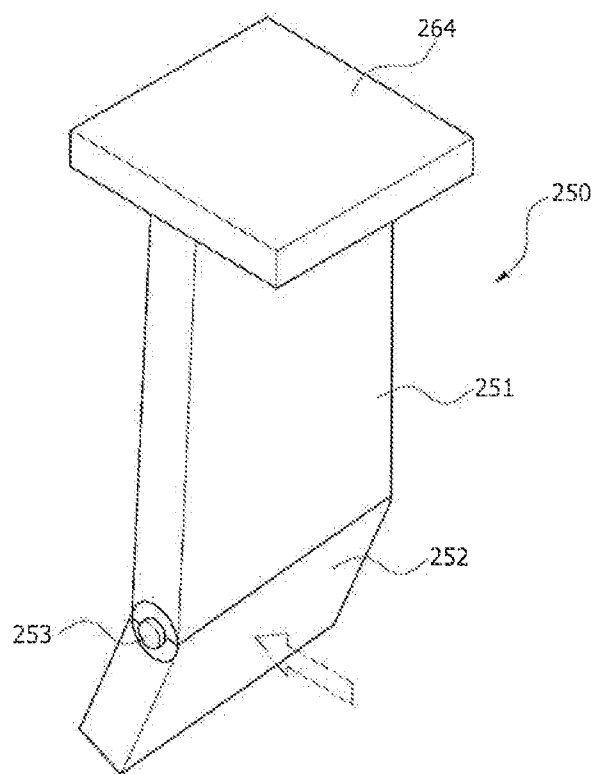
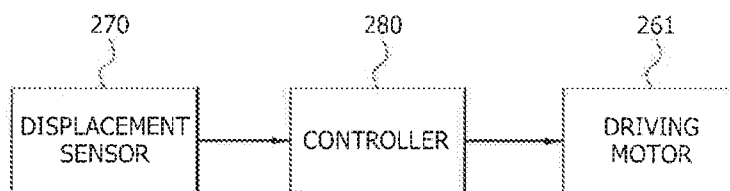


FIG.27



STEAM-BLOCKING APPARATUS

CROSS REFERENCE TO RELATED APPLICATION

[0001] The present application is a continuation of International Application No. PCT/KR2011/010011 filed on Dec. 22, 2011, which claims priority to Korean Application No. 10-2011-0039422 filed Apr. 27, 2011 and Korean Application No. 10-2011-0051144 filed May 30, 2011, which applications are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present invention relates to a steam-blocking apparatus, and more particularly, to a steam-blocking apparatus which is capable of blocking steam, generated from evaporation of wash water sprayed from a descaler, from being introduced into a width-measuring part, thereby improving precision when the width of a material is measured.

BACKGROUND ART

[0003] In general, a steel manufacturing process includes an iron-making process of manufacturing liquid steel, a steel-making process of removing impurities from the liquid steel, a continuous casting process of casting the liquid steel into solid steel, and a rolling process of rolling the solid steel into a steel sheet or wire.

[0004] The rolling process refers to a process of passing an intermediate material such as slab or bloom, manufactured during the continuous casting process, between a plurality of rotating rollers and applying a continuous force to enlarge or thin the intermediate material. The roller process is roughly divided into a hot rolling process and a cold rolling process.

[0005] The above-described configuration is a related art for helping an understanding of the present invention, and does not mean a related art which is widely known in the technical field to which the present invention pertains.

SUMMARY

[0006] The present invention is conceived to solve such problems of the related art, and an aspect of the invention is to provide a steam-blocking apparatus which is capable of blocking steam, generated from evaporation of wash water sprayed from a descaler, from being introduced into a width-measuring part, thereby improving precision when the width of a material is measured.

[0007] According to an aspect of the invention, a steam-blocking apparatus includes: a rolling mill configured to roll a material; a transfer roller disposed at a rear side of the rolling mill and configured to transfer the material from the rolling mill; a descaler disposed above the transfer roller and configured to spray wash water toward the transfer roller; a width-measuring part disposed at a rear side of the descaler and configured to measure the width of the material; and a shield disposed between the descaler and the width-measuring part and configured to prevent steam, generated from evaporation of the wash water, from being introduced into the width-measuring part.

[0008] The shield may include: a body fixed to an external device; and a rotating part rotatably coupled to the body.

[0009] The shield may further include a fluid sprayer disposed at a bottom of the rotating part and configured to spray a fluid toward the transfer roller.

[0010] The fluid sprayer may include: a connection pipe that communicates with an external supply source to supply a fluid; a diverging pipe that diverges from the connection pipe; and a nozzle disposed at the diverging portion to spray the fluid toward the transfer roller.

[0011] The steam-blocking apparatus further include: an elevating part coupled to the shield and configured to lift or lower the shield; and a controller configured to operate the elevating part.

[0012] The elevating part may include: a driving motor fixed to an external device; a rotating gear connected to the driving motor and rotated using power provided from the driving motor; a rack gear engaged with the rotating gear and lifted or lowered by the rotation of the rotating gear; and a connection plate having one side coupled to the rack gear and the other side coupled to the shield.

[0013] The steam-blocking apparatus may further include a displacement sensor installed on the connection plate and configured to sense a distance from the material, wherein the controller is configured to operate the driving motor based on the distance from the material, measured by the displacement sensor.

[0014] According to another aspect of the present invention, a steam-blocking apparatus includes: a rolling mill configured to roll a material; a transfer roller disposed at a rear side of the rolling mill and configured to transfer the material from the rolling mill; a descaler disposed above the transfer roller and configured to spray wash water toward the transfer roller; a width-measuring part disposed at a rear side of the descaler and configured to measure the width of the material; and a shield disposed between the descaler and the width-measuring part, and configured to suction air in the width-measuring part and spray the suctioned air toward the transfer roller to block steam, generated from evaporation of the wash water, from being introduced into the width-measuring part.

[0015] The shield may include: a body fixed to an external device; and an air-curtain rotatably coupled to a bottom of the body, configured to suction the air in the width-measuring part and spray the suctioned air toward the transfer roller.

[0016] The air-curtain may include: a case having an inlet formed at a side facing the width-measuring part and an outlet formed at a side facing the transfer roller; a fan rotatably installed within the case; and a fan motor disposed within the case and configured to rotate the fan.

[0017] The steam-blocking apparatus may further include: an elevating part coupled to the shield and configured to lift or lower the shield; and a controller configured to operate the elevating part.

[0018] The elevating part may include: a driving motor fixed to an external device; a rotating gear connected to the driving motor and rotated using power provided from the driving motor; a rack gear engaged with the rotating gear and lifted or lowered by the rotation of the rotating gear; and a connection plate having one side coupled to the rack gear and the other side coupled to the shield.

[0019] The steam-blocking apparatus may further include a displacement sensor installed on the connection plate and configured to sense a distance from the material, wherein the controller is configured to operate the driving motor based on the distance from the material, measured by the displacement sensor.

[0020] The shield may include: a body fixed to the connection plate; and an air-curtain rotatably coupled to a bottom of

the body and configured to suction air in the width-measuring part and spray the suctioned air toward the transfer roller.

[0021] According to the embodiments of the invention, since the steam-blocking apparatus blocks steam, generated from the evaporation of wash water sprayed from the descaler, from being introduced into the width-measuring part, the width of the material may be precisely measured.

[0022] Furthermore, since the rotating part is rotatably coupled to the body, impact may be reduced when the material collides with the rotating part.

[0023] Furthermore, since the height of the shield may be controlled, the collision between the material and the shield may be prevented. Furthermore, since the shield may be positioned close to the material, the introduction of steam through a gap between the shield and the material may be minimized.

BRIEF DESCRIPTION OF DRAWINGS

[0024] The above and other aspects, features and advantages of the invention will become apparent from the following detailed description in conjunction with the accompanying drawings, in which:

[0025] FIG. 1 is a perspective view of a steam-blocking apparatus in accordance with a first embodiment of the present invention;

[0026] FIG. 2 is a perspective view of a shield of the steam-blocking apparatus in accordance with the first embodiment of the present invention;

[0027] FIG. 3 is a cross-sectional view of a fluid sprayer of the steam-blocking apparatus in accordance with the first embodiment of the present invention;

[0028] FIG. 4 is a bottom view of the fluid sprayer of the steam-blocking apparatus in accordance with the first embodiment of the present invention;

[0029] FIG. 5 is a perspective view illustrating a state in which a rotating part of the steam-blocking apparatus in accordance with the first embodiment of the present invention is rotated to the right;

[0030] FIG. 6 is a perspective view illustrating a state in which the rotating part of the steam-blocking apparatus in accordance with the first embodiment of the present invention is rotated to the left;

[0031] FIG. 7 is a perspective view of a steam-blocking apparatus in accordance with a second embodiment of the present invention;

[0032] FIG. 8 is a perspective view of a shield of the steam-blocking apparatus in accordance with the second embodiment of the present invention;

[0033] FIG. 9 is a perspective view of an air-curtain of the steam-blocking apparatus in accordance with the second embodiment of the present invention;

[0034] FIG. 10 is a side view of the steam-blocking apparatus in accordance with the second embodiment of the present invention;

[0035] FIG. 11 illustrates an operation state of the steam-blocking apparatus in accordance with the second embodiment of the present invention, when a distal end of a material passes through a shield;

[0036] FIG. 12 illustrates an operation state of the steam-blocking apparatus in accordance with the second embodiment of the present invention, when a central portion of the material passes through the shield;

[0037] FIG. 13 illustrates an operation state of the steam-blocking apparatus in accordance with the second embodiment of the present invention, when a tail end of the material passes through the shield;

[0038] FIG. 14 is a perspective view illustrating a state in which the air-curtain of the steam-blocking apparatus in accordance with the second embodiment of the present invention is rotated to the right;

[0039] FIG. 15 is a perspective view illustrating a state in which the air-curtain of the steam-blocking apparatus in accordance with the second embodiment of the present invention is rotated to the left;

[0040] FIG. 16 is a block diagram illustrating a control flow of the steam-blocking apparatus in accordance with the second embodiment of the present invention;

[0041] FIG. 17 is a perspective view of a steam-blocking apparatus in accordance with a third embodiment of the present invention;

[0042] FIG. 18 is a perspective view of a shield of the steam-blocking apparatus in accordance with the third embodiment of the present invention;

[0043] FIG. 19 is a cross-sectional view of a fluid sprayer of the steam-blocking apparatus in accordance with the third embodiment of the present invention;

[0044] FIG. 20 is a bottom view of the fluid sprayer of the steam-blocking apparatus in accordance with the third embodiment of the present invention;

[0045] FIG. 21 is a side view of the steam-blocking apparatus in accordance with the third embodiment of the present invention;

[0046] FIG. 22 illustrates an operation state of the steam-blocking apparatus in accordance with the third embodiment of the present invention, when a distal end of a material passes through the shield;

[0047] FIG. 23 illustrates an operation state of the steam-blocking apparatus in accordance with the third embodiment of the present invention, when a central portion of the material passes through the shield;

[0048] FIG. 24 illustrates an operation state of the steam-blocking apparatus in accordance with the third embodiment of the present invention, when a tail end of the material passes through the shield;

[0049] FIG. 25 is a perspective view illustrating a state in which the fluid sprayer of the steam-blocking apparatus in accordance with the third embodiment of the present invention is rotated to the right;

[0050] FIG. 26 is a perspective view illustrating a state in which the fluid sprayer of the steam-blocking apparatus in accordance with the third embodiment of the present invention is rotated to the left; and

[0051] FIG. 27 is a block diagram illustrating a control flow of the steam-blocking apparatus in accordance with the third embodiment of the present invention.

DETAILED DESCRIPTION

[0052] Embodiments of the invention will hereinafter be described in detail with reference to the accompanying drawings. It should be noted that the drawings are not to precise scale and may be exaggerated in thickness of lines or sizes of components for descriptive convenience and clarity only. Furthermore, the terms as used herein are defined by taking functions of the invention into account and can be changed according to the custom or intention of users or operators.

Therefore, definition of the terms should be made according to the overall disclosures set forth herein.

[0053] FIG. 1 is a perspective view of a steam-blocking apparatus in accordance with a first embodiment of the present invention. FIG. 2 is a perspective view of a shield of the steam-blocking apparatus in accordance with the first embodiment of the present invention. FIG. 3 is a cross-sectional view of a fluid sprayer of the steam-blocking apparatus in accordance with the first embodiment of the present invention. FIG. 4 is a bottom view of the fluid sprayer of the steam-blocking apparatus in accordance with the first embodiment of the present invention. FIG. 5 is a perspective view illustrating a state in which a rotating part of the steam-blocking apparatus in accordance with the first embodiment of the present invention is rotated to the right. FIG. 6 is a perspective view illustrating a state in which the rotating part of the steam-blocking apparatus in accordance with the first embodiment of the present invention is rotated to the left.

[0054] FIG. 7 is a perspective view of a steam-blocking apparatus in accordance with a second embodiment of the present invention. FIG. 8 is a perspective view of a shield of the steam-blocking apparatus in accordance with the second embodiment of the present invention. FIG. 9 is a perspective view of an air-curtain of the steam-blocking apparatus in accordance with the second embodiment of the present invention. FIG. 10 is a side view of the steam-blocking apparatus in accordance with the second embodiment of the present invention. FIG. 11 illustrates an operation state of the steam-blocking apparatus in accordance with the second embodiment of the present invention, when a distal end of a material passes through a shield. FIG. 12 illustrates an operation state of the steam-blocking apparatus in accordance with the second embodiment of the present invention, when a central portion of the material passes through the shield. FIG. 13 illustrates an operation state of the steam-blocking apparatus in accordance with the second embodiment of the present invention, when a tail end of the material passes through the shield. FIG. 14 is a perspective view illustrating a state in which the air-curtain of the steam-blocking apparatus in accordance with the second embodiment of the present invention is rotated to the right. FIG. 15 is a perspective view illustrating a state in which the air-curtain of the steam-blocking apparatus in accordance with the second embodiment of the present invention is rotated to the left. FIG. 16 is a block diagram illustrating a control flow of the steam-blocking apparatus in accordance with the second embodiment of the present invention.

[0055] FIG. 17 is a perspective view of a steam-blocking apparatus in accordance with a third embodiment of the present invention. FIG. 18 is a perspective view of a shield of the steam-blocking apparatus in accordance with the third embodiment of the present invention. FIG. 19 is a cross-sectional view of a fluid sprayer of the steam-blocking apparatus in accordance with the third embodiment of the present invention. FIG. 20 is a bottom view of the fluid sprayer of the steam-blocking apparatus in accordance with the third embodiment of the present invention. FIG. 21 is a side view of the steam-blocking apparatus in accordance with the third embodiment of the present invention. FIG. 22 illustrates an operation state of the steam-blocking apparatus in accordance with the third embodiment of the present invention, when a distal end of a material passes through the shield. FIG. 23 illustrates an operation state of the steam-blocking apparatus in accordance with the third embodiment of the present inven-

tion, when a central portion of the material passes through the shield. FIG. 24 illustrates an operation state of the steam-blocking apparatus in accordance with the third embodiment of the present invention, when a tail end of the material passes through the shield. FIG. 25 is a perspective view illustrating a state in which the fluid sprayer of the steam-blocking apparatus in accordance with the third embodiment of the present invention is rotated to the right. FIG. 26 is a perspective view illustrating a state in which the fluid sprayer of the steam-blocking apparatus in accordance with the third embodiment of the present invention is rotated to the left. FIG. 27 is a block diagram illustrating a control flow of the steam-blocking apparatus in accordance with the third embodiment of the present invention.

[0056] Referring to FIGS. 1 to 4, the steam-blocking apparatus in accordance with the first embodiment of the present invention includes a rolling mill 10, a transfer roller 20, a descender 30, a width-measuring part 40, and a shield 50.

[0057] The rolling mill 10 rolls a material S to a target thickness and width such that the material S may be easily finish-rolled during a finish rolling process. The rolling mill 10 includes an upper work roll disposed in the upper side and a lower work roll disposed in the lower side. Reference numerals of the upper and lower work rolls are omitted.

[0058] The material S is rolled by the upper work roll and the lower work roll, while transferred between the upper and lower work rolls. The material S, which is rolled by the rolling mill 10 and then transferred, is transferred to a subsequent process through a transfer roller 20.

[0059] The transfer roller 20 is disposed at a rear side of the rolling mill 10. The transfer roller 20 includes transfer rolls with no reference numeral and a roll support (not illustrated). The transfer rolls transfer the material S to a subsequent process, and the roll support rotatably supports both ends of the transfer rolls.

[0060] The descender 30 is disposed above the transfer roller 20. The descender 30 sprays high-pressure wash water toward the transfer roller 20, and removes scale formed on the material S transferred by the transfer roller 20.

[0061] The descender 30 is disposed at the front side of the width-measuring part 40, based on FIG. 1. Thus, the scale formed on the surface of the material S is removed through the descender 30, before the material S passes through the width-measuring part 40. Therefore, it is possible to prevent the reduction in measurement precision of the width-measuring part 40, which may be caused by the scale formed on the material S.

[0062] The width-measuring part 40 is disposed above the transfer roller 20. The width-measuring part 40 measures the width of the material S transferred by the transfer roller 20. The width-measuring part 40 may include a laser displacement sensor.

[0063] The laser displacement sensor is disposed above the transfer roller 20 forming a transfer path of the material S, and irradiates laser toward the transfer roller 20. When the material S passes through the point at which laser is irradiated, the laser reflected from the surface of the material S is received by the laser displacement sensor. The laser displacement sensor measures the width of the material S by the received laser.

[0064] When having measured the width of the material S, the width-measuring part 40 transmits the measured width to a controller (not illustrated). The controller controls a subsequent rolling process, based on the received width information of the material S.

[0065] The shield 50 is disposed above the transfer roller 20. The shield 50 is disposed between the descender 30 and the width-measuring part 40, and prevents steam, which may reduce the measurement precision of the width-measuring part 40, from being introduced into the width-measuring part 40.

[0066] The wash water sprayed from the descender 30 comes in contact with the high-temperature material S, and then evaporates into steam. The shield 50 prevents the steam from being introduced into the width-measuring part 40.

[0067] The shield 50 includes a body 51, a rotating part 52, and a fluid sprayer 54.

[0068] The body 51 is fixed to an external device F. The external device F may include a rolling frame or roller table which forms the frame of the rolling mill 10. In addition, the external device F may include any structures as long as the body 51 can be disposed above the transfer roller 20.

[0069] The rotating part 52 is rotatably hinge-coupled to the body 51. The top of the rotating part 52 is hinge-coupled to the bottom of the body 51 through a hinge part 53, based on FIG. 2. Thus, the rotating part 52 may freely rotate with respect to the body 1.

[0070] The material S may bounce upward while the material S is transferred in a forward or backward direction. In this case, when the material S collides with the rotating part 52, impact therebetween may be reduced because the rotating part 52 is rotatably coupled to the body 51.

[0071] FIG. 5 illustrates a state in which the rotating part 52 collides with the material S and rotates to the right, while the material S is transferred in the forward direction. FIG. 6 illustrates a state in which the rotating part 52 collides with the material S and rotates to the left, while the material S is transferred in the backward direction. As such, when the rotating part 52 collides with the material S, the rotating part 52 rotates in the transfer direction of the material S. Thus, it is possible to minimize the impact caused by the collision.

[0072] The fluid sprayer 54 is disposed at the bottom of the rotating part 52. The fluid sprayer 54 sprays a high-pressure fluid toward the transfer roller 20, that is, the material S transferred by the transfer roller 20, thereby preventing steam from being introduced into the width-measuring part 40 through a gap between the fluid sprayer 54 and the transfer roller 20. In the present embodiment, the fluid is air. Since the fluid sprayed from the fluid sprayer 54 may prevent steam from being introduced into the width-measuring part 40, the width of the material S may be precisely measured by the width-measuring part 40.

[0073] The fluid sprayer 54 includes a connection pipe 55, a diverging pipe 56, a nozzle 57, and a housing 58. The connection pipe 55 is connected to an external supply source and guides a fluid received from the external supply source to the diverging pipe 56.

[0074] The diverging pipe 56 includes a plurality of pipes diverging from the connection pipe 55, and the plurality of diverging pipes 56 are arranged in a line in the widthwise direction of the material S. Thus, the diverging pipes 56 block a wide range of the path through which steam is introduced into the width-measuring part 40.

[0075] The nozzle 57 is disposed at one end of the diverging pipe 56 and sprays a high-pressure fluid toward the transfer roller 20, that is, the material S transferred by the transfer roller 20. Thus, an air curtain is formed between the fluid sprayer 54 and the material S, thereby blocking steam from being introduced into the width-measuring part 40.

[0076] The housing 58 covers the connection pipe 55, the diverging pipes 56, and the nozzles 57. Thus, the housing 58 prevents the damage of the connection pipe 55, the diverging pipes 56, and the nozzles 57, which may occur when the connection pipe 55, the diverging pipes 56, and the nozzles 57 collide with the material S. Furthermore, the housing 58 suppresses the degradation and damage of the connection pipe 55, the diverging pipes 56, and the nozzles 57, which may occur under a high-pressure environment.

[0077] Referring to FIGS. 7 to 10, a steam-blocking apparatus in accordance with a second embodiment of the present invention includes a rolling mill 110, a transfer roller 120, a descender 130, a width-measuring part 140, a shield 150, and a controller 180.

[0078] The rolling mill 110 rolls a material S to a target thickness and width such that the material S may be easily finished-rolled during a finish rolling process. The rolling mill 110 includes an upper work roll disposed in the upper side and a lower work roll disposed in the lower side. Reference numerals of the upper and lower work rolls are omitted.

[0079] The material S is rolled by the upper work roll and the lower work roll, while transferred between the upper and lower work roll. The material S, which is rolled by the rolling mill 110 and then transferred, is transferred to a subsequent process by a transfer roller 120.

[0080] The transfer roller 120 is disposed at the rear side of the rolling mill 110. The transfer roller 120 includes transfer rollers with no reference numeral and a roller support (not illustrated). The transfer rollers transfer the material S to a subsequent process, and the roller support rotatably supports both ends of the transfer rollers.

[0081] The descender 130 is disposed above the transfer roller 120. The descender 130 sprays high-pressure wash water toward the transfer roller 120, and removes scale formed on the material S transferred by the transfer roller 120.

[0082] The descender 130 is disposed at the front side of the width-measuring part 140, based on FIG. 7. Thus, the scale formed on the surface of the material S is removed by the descender 130, before the material S passes through the width-measuring part 140. Therefore, it is possible to prevent the reduction in measurement precision of the width-measuring part 140, which may be caused by the scale formed on the material S.

[0083] The width-measuring part 140 is disposed above the transfer roller 120. The width-measuring part 140 measures the width of the material S transferred by the transfer roller 120. The width-measuring part 140 may include a laser displacement sensor.

[0084] The laser displacement sensor is disposed above the transfer roller 120 forming a transfer path of the material S, and irradiates laser toward the transfer roller 120. When the material S passes through a point at which laser is irradiated, the laser reflected from the surface of the material S is received by the laser displacement sensor. The laser displacement sensor measures the width of the material S by the received laser.

[0085] When having measured the width of the material S, the width-measuring part 140 transmits the measured width to a controller 180. The controller 180 controls a subsequent rolling process, based on the received width information of the material S.

[0086] The shield 150 is disposed above the transfer roller 120. The shield 150 is disposed between the descender 130 and the width-measuring part 140, and prevents steam, which

may reduce the measurement precision of the width-measuring part 140, from being introduced into the width-measuring part 140.

[0087] The wash water sprayed from the descaler 130 comes in contact with the high-temperature material S, and then evaporates into steam. The shield 150 prevents the steam from being introduced into the width-measuring part 140.

[0088] The shield 150 includes a body 151 and an air-curtain 152.

[0089] The body 151 is fixed to an external device F or elevating part 160. The external device F may include a rolling frame or roller table forming the frame of the rolling mill 110. In addition, the external device F may include any structures as long as the body 151 can be disposed above the transfer roller 120. When the body 151 is fixed to the external device F, the shield 150 is not moved in a vertical direction, and when the body 151 is coupled to the elevating part 160, the shield 150 may be moved in the vertical direction.

[0090] The air-curtain 152 is rotatably hinge-coupled to the body 151. The top of the air-curtain 152 is hinge-coupled to the bottom of the body 151 through the hinge part 153, based on FIG. 8. Thus, the air-curtain 152 may freely rotate with respect to the body 151.

[0091] The material S may bounce upward while the material S is transferred in a forward or backward direction. In this case, when the material S collides with the air-curtain 152, impact therebetween may be reduced because the air-curtain 152 is rotatably coupled to the body 151.

[0092] FIG. 14 illustrates a state in which the air-curtain 152 collides with the material S and rotates to the right, while the material S is transferred in the forward direction. FIG. 15 illustrates a state in which the air-curtain 152 collides with the material S and rotates to the left, while the material S is transferred in the backward direction. As such, when the air-curtain 152 collides with the material S, the air-curtain 152 rotates in the transfer direction of the material S. Thus, it is possible to minimize the impact caused by the collision.

[0093] The air-curtain 152 sprays air toward the transfer roller 120, that is, the material S transferred by the transfer roller 120, thereby blocking steam from being introduced to the width-measuring part 140 through a gap between the air-curtain 152 and the material S. Since the air sprayed from the air-curtain 152 may block steam from being introduced into the width-measuring part 140, it is possible to precisely measure the width of the material S by the width-measuring part 140.

[0094] The air-curtain 152 sucks air in the width-measuring part 140 and sprays the sucked air toward to the transfer roller 120. Thus, since air does not need to be separately supplied from outside, it is possible to simplify the equipment and reduce the cost.

[0095] The air-curtain 152 includes a case 155, a fan 156, and a fan motor 157. The case 155 is hinge-coupled to the body 151, and forms the exterior of the air-curtain 152. The case 155 has an inlet 155a formed at a side facing the width-measuring part 140 and an outlet 155b formed at a side facing the transfer roller 120.

[0096] The fan 156 is rotatably installed within the case 155, and the fan motor 157 is disposed within the case 155 and generates power to rotate the fan 156. When the fan motor 157 is driven according to a command from the controller 180, the fan 156 is rotated. When the fan 156 is rotated, the air in the

width-measuring part 140 is sucked into the case 155 through the inlet 155a, and then discharged toward the transfer roller 120 through the outlet 155b.

[0097] Since an air curtain is formed between the air-curtain 152 and the material S through the air discharged through the outlet 155b, the air curtain prevents steam from being introduced into the width-measuring part 140 through a gap between the air-curtain 152 and the material S.

[0098] Referring to FIGS. 10 to 13 and 16, the steam-blocking apparatus in accordance with the second embodiment of the present invention may further include an elevating part 160 and a displacement sensor 170.

[0099] The elevating part 160 is coupled to the shield 150 so as to lift or lower the shield 150. The elevating part 160 includes a driving motor 161, a rotating gear 162, a rack gear 163, and a connection plate 164. In the case of the steam-blocking apparatus which additionally includes the elevating part 160, the body 151 is coupled to the connection plate 164, instead of the external device F.

[0100] The driving motor 161 generates power and is fixed to the external device F. The external device F may include a rolling frame or roller table forming the frame of the rolling mill 110. In addition, the external device F may include any devices as long as the devices can fix the driving motor 161.

[0101] The rotating gear 162 is connected to the driving motor 161, and rotated using power received from the driving motor 161, when the driving motor 161 is driven. The rack gear 163 is engaged with the rotating gear 162, and lifted or lowered by the rotation of the rotating gear 162. One side of the connection plate 164 is coupled to the rack gear 163, and the other side of the connection plate 164 is coupled to the body 151 of the shield 150. Thus, when the rack gear 163 is lifted or lowered by the operation of the driving motor 161, the shield 150 is lifted or lowered in the same direction as the rack gear 163. That is, the shield 150 may be lifted or lowered by the driving motor 161 of which the operation is controlled by the controller 180.

[0102] The displacement sensor 170 is installed on the connection plate 164, and senses a distance from the material S. The displacement sensor 170 is disposed closer to the rolling mill 110 than the shield 150 such that the material S first passes through the bottom of the displacement sensor 170 before the bottom of the shield 150.

[0103] The displacement sensor 170 transmits the measured distance from the material S to the controller 180, and the controller 180 controls the operation of the driving motor 161 based on the measured distance. In order to block steam from being introduced through a gap between the shield 150 and the material S, the air-curtain 152 must be operated, and the gap between the shield 150 and the material S must be minimized. In this case, when the shield 150 is positioned close to the material S, an upward bending of the material S may collide with the shield 150. Then, the shield 150 may be damaged. In order to prevent the damage of the shield 150, the displacement sensor 170 informs the controller 180 of the distance from the material S, when the distance from the material S is measured to be smaller than a preset reference value. Then, the controller 180 controls the driving motor 161 to lift the shield 150 (refer to FIGS. 11 and 13). Furthermore, when the distance from the material S is measured to be larger than the preset reference value, the displacement sensor 170 informs the controller 180 of the distance from the material S. Then, the controller 180 controls the driving motor 161 to lower the shield 150 (refer to FIG. 12). At this time, the lifting

of the shield 150 is performed while the rotating gear 162 is rotated in one direction by the driving motor 16 and the rack gear 163 engaged with the rotating gear 162 is moved upward. That is, the shield 150 is lifted by the upward movement of the rack gear 163. On the other hand, the lowering of the shield 150 is performed while the rotating gear 162 is rotated in the other direction by the driving motor 161 and the rack gear 163 engaged with the rotating gear 162 is moved downward. That is, the shield 150 is lowered by the downward movement of the rack gear 163.

[0104] Referring to FIGS. 17 to 21, a steam-blocking apparatus in accordance with a third embodiment of the present invention includes a rolling mill 210, a transfer roller 220, a descaler 230, a width-measuring part 240, a shield 250, an elevating part 260, a displacement sensor 270, and a controller 280.

[0105] The rolling mill 210 rolls a material S to a target thickness and width such that the material S may be easily finished-rolled during a finish rolling process. The rolling mill 210 includes an upper work roll disposed in the upper side and a lower work roll disposed in the lower side. Reference numerals of the upper and lower work rolls are omitted.

[0106] The material S is rolled by the upper work roll and the lower work roll, while transferred between the upper and lower work rolls. The material S, which is rolled by the rolling mill 210 and then transferred, is transferred to a subsequent process by a transfer roller 220.

[0107] The transfer roller 220 is disposed at the rear side of the rolling mill 210. The transfer roller 220 includes transfer rollers with no reference numeral and a roller support (not illustrated). The transfer rollers transfer the material S to a subsequent process, and the roller support rotatably supports both ends of the transfer rollers.

[0108] The descaler 230 is disposed above the transfer roller 220. The descaler 230 sprays high-pressure wash water toward the transfer roller 220, and removes scale formed on the material S transferred by the transfer roller 220.

[0109] The descaler 230 is disposed at the front side of the width-measuring part 240, based on FIG. 17. Thus, the scale formed on the surface of the material S is removed by the descaler 230, before the material S passes through the width-measuring part 240. Therefore, it is possible to prevent the reduction in measurement precision of the width-measuring part 240, which may be caused by the scale formed on the material S.

[0110] The width-measuring part 240 is disposed above the transfer roller 220. The width-measuring part 240 measures the width of the material S transferred by the transfer roller 220. The width-measuring part 240 may include a laser displacement sensor.

[0111] The laser displacement sensor is disposed above the transfer roller 220 forming a transfer path of the material S, and irradiates laser toward the transfer roller 220. When the material S passes through a point at which laser is irradiated, the laser reflected from the surface of the material S is received by the laser displacement sensor. The laser displacement sensor measures the width of the material S by the received laser.

[0112] When having measured the width of the material S, the width-measuring part 240 transmits the measured width to a controller 280. The controller 280 controls a subsequent rolling process, based on the received width information of the material S.

[0113] The shield 250 is disposed above the transfer roller 220. The shield 250 is disposed between the descaler 230 and the width-measuring part 240, and prevents steam, which may reduce the measurement precision of the width-measuring part 240, from being introduced into the width-measuring part 240.

[0114] The wash water sprayed from the descaler 230 comes in contact with the high-temperature material S, and then evaporates into steam. The shield 250 prevents the steam from being introduced into the width-measuring part 240.

[0115] The shield 250 includes a body 251 and a fluid sprayer 252. The body 251 is coupled to the elevating part 260. The fluid sprayer 252 is rotatably hinge-coupled to the body 251. The top of the fluid sprayer 252 is hinge-coupled to the bottom of the body 251 through a hinge part 253, based on FIG. 18. Thus, the fluid sprayer 252 may freely rotate with respect to the body 251.

[0116] The material S may bounce upward while the material S is transferred in a forward or backward direction. In this case, when the material S collides with the fluid sprayer 252, impact therebetween may be reduced because the fluid sprayer 252 is rotatably coupled to the body 251.

[0117] FIG. 25 illustrates a state in which the fluid sprayer 252 collides with the material S and rotates to the right, while the material S is transferred in the forward direction. FIG. 26 illustrates a state in which the fluid sprayer 252 collides with the material S and rotates to the left, while the material S is transferred in the backward direction. As such, when the fluid sprayer 252 collides with the material S, the fluid sprayer 252 rotates in the transfer direction of the material S. Thus, it is possible to minimize the impact caused by the collision.

[0118] The fluid sprayer 252 sprays a high-pressure fluid toward the transfer roller 220, that is, the material S transferred by the transfer roller 220, thereby blocking steam from being introduced to the width-measuring part 240 through a gap between the fluid sprayer 252 and the transfer roller 220. In the present embodiment, the fluid is air. Since the fluid sprayed from the fluid sprayer 252 may block steam from being introduced into the width-measuring part 240, it is possible to precisely measure the width of the material S by the width-measuring part 240.

[0119] The fluid sprayer 252 includes a connection pipe 255, a diverging pipe 256, a nozzle 257, and a housing 258. The connection pipe 255 is connected to an external supply source, and guides a fluid received from the external supply source to the diverging pipe 256.

[0120] The diverging pipe 256 includes a plurality of pipes diverging from the connection pipe 255, and the plurality of diverging pipes 256 are arranged in a line in the widthwise direction of the material S. Thus, the diverging pipes 256 block a wide range of the path through which the steam is introduced into the width-measuring pipe 240.

[0121] The nozzle 257 is disposed at one end of the diverging pipe 256 and sprays a high-pressure fluid toward the transfer roller 220, or specifically, the material S transferred by the transfer roller 20. Thus, an air curtain is formed between the fluid sprayer 252 and the material S, thereby blocking steam from being introduced into the width-measuring part 240.

[0122] The housing 258 covers the connection pipe 255, the diverging pipes 256, and the nozzles 257. Thus, the housing 258 prevents the damage of the connection pipe 255, the diverging pipes 256, and the nozzles 257, which may occur when the connection pipe 255, the diverging pipes 256, and

the nozzles 257 collide with the material S. Furthermore, the housing 268 suppresses the degradation and damage of the connection pipe 255, the diverging pipe 256, and the nozzle 257, which may occur under a high-pressure environment.

[0123] The elevating part 260 is coupled to the shield 250 so as to lift or lower the shield 250. The elevating part 260 includes a driving motor 261, a rotating gear 262, a rack gear 263, and a connection plate 264.

[0124] The driving motor 261 generates power and is fixed to the external device F. The external device F may include a rolling frame or roller table forming the frame of the rolling mill 210. In addition, the external device F may include any devices as long as the devices can fix the driving motor 261.

[0125] The rotating gear 262 is connected to the driving motor 261, and rotated using power received from the driving motor 261, when the driving motor 261 is driven. The rack gear 263 is engaged with the rotating gear 262, and lifted or lowered by the rotation of the rotating gear 262. One side of the connection plate 264 is coupled to the rack gear 263, and the other side of the connection plate 264 is coupled to the body 251 of the shield 250. Thus, when the rack gear 263 is lifted or lowered by the operation of the driving motor 261, the shield 250 is lifted or lowered in the same direction as the rack gear 263. That is, the shield 250 may be lifted or lowered by the driving motor 261 of which the operation is controlled using the controller 280.

[0126] Referring to FIGS. 21 to 24 and 27, the displacement sensor 270 is installed on the connection plate 264, and senses a distance from the material S. The displacement sensor 270 is disposed closer to the rolling mill 210 than the shield 250 such that the material S passes through the bottom of the displacement sensor 270 before the bottom of the shield 250.

[0127] The displacement sensor 270 transmits the measured distance from the material S to the controller 280, and the controller 280 controls the operation of the driving motor 261 based on the measured distance. In order to block steam from being introduced through a gap between the shield 250 and the material S, the gap between the shield 250 and the material S may be minimized. In this case, when the shield 250 is positioned close to the material S, an upward bending of the material S may collide with the shield 250. Then, the shield 250 may be damaged. In order to prevent the damage of the shield 250, the displacement sensor 270 informs the controller 280 of the distance from the material S, when the distance from the material S is measured to be smaller than a preset reference value. Then, the controller 280 controls the driving motor 261 to lift the shield 250 (refer to FIGS. 22 and 24). Furthermore, when the distance from the material S is measured to be larger than the preset reference value, the displacement sensor 270 informs the controller 280 of the distance from the material S. Then, the controller 280 controls the driving motor 261 to lower the shield 250 (refer to FIG. 23). At this time, the lifting of the shield 250 is performed while the rotating gear 262 is rotated in one direction by the driving motor 261 and the rack gear 263 engaged with the rotating gear 262 is moved upward. That is, the shield 250 is lifted through the upward movement of the rack gear 263. On the other hand, the lowering of the shield 250 is performed while the rotating gear 262 is rotated in the other direction by the driving motor 261 and the rack gear 263 engaged with the rotating gear 262 is moved downward. That is, the shield 250 is lowered through the downward movement of the rack gear 263.

[0128] Although some embodiments have been provided to illustrate the invention in conjunction with the drawings, it will be apparent to those skilled in the art that the embodiments are given by way of illustration only, and that various modifications and equivalent embodiments can be made without departing from the spirit and scope of the invention. The scope of the invention should be limited only by the accompanying claims.

What is claimed is:

1. A steam-blocking apparatus comprising:
 - a rolling mill configured to roll a material;
 - a transfer roller disposed at a rear side of the rolling mill and configured to transfer the material from the rolling mill;
 - a descaler disposed above the transfer roller and configured to spray wash water toward the transfer roller;
 - a width-measuring part disposed at a rear side of the descaler and configured to measure the width of the material; and
 - a shield disposed between the descaler and the width-measuring part and configured to prevent steam, generated from evaporation of the wash water, from being introduced into the width-measuring part.
2. The steam-blocking apparatus of claim 1, wherein the shield includes:
 - a body fixed to an external device; and
 - a rotating part rotatably coupled to the body.
3. The steam-blocking apparatus of claim 2, wherein the shield further includes:
 - a fluid sprayer disposed at a bottom of the rotating part and configured to spray a fluid toward the transfer roller.
4. The steam-blocking apparatus of claim 3, wherein the fluid sprayer includes:
 - a connection pipe that communicates with an external supply source to supply a fluid;
 - a diverging pipe that diverges from the connection pipe; and
 - a nozzle disposed at the diverging portion to spray the fluid toward the transfer roller.
5. The steam-blocking apparatus of claim 1, further comprising:
 - an elevating part coupled to the shield and configured to lift or lower the shield; and
 - a controller configured to operate the elevating part.
6. The steam-blocking apparatus of claim 5, wherein the elevating part includes:
 - a driving motor fixed to an external device;
 - a rotating gear connected to the driving motor and rotated using power provided from the driving motor;
 - a rack gear engaged with the rotating gear and lifted or lowered by the rotation of the rotating gear; and
 - a connection plate having one side coupled to the rack gear and the other side coupled to the shield.
7. The steam-blocking apparatus of claim 6, further comprising:
 - a displacement sensor installed on the connection plate and configured to sense a distance from the material, wherein the controller is configured to operate the driving motor based on the distance from the material, measured using the displacement sensor.

- 8.** A steam-blocking apparatus comprising:
a rolling mill configured to roll a material;
a transfer roller disposed at a rear side of the rolling mill and configured to transfer the material from the rolling mill;
a descaler disposed above the transfer roller and configured to spray wash water toward the transfer roller;
a width-measuring part disposed at a rear side of the descaler and configured to measure the width of the material; and
a shield disposed between the descaler and the width-measuring part, and configured to suction air in the width-measuring part and spray the suctioned air toward the transfer roller to block steam, generated from evaporation of the wash water, from being introduced into the width-measuring part.
- 9.** The steam-blocking apparatus of claim **8**, wherein the shield includes:
a body fixed to an external device; and
an air-curtain rotatably coupled to a bottom of the body, configured to suction the air in the width-measuring part and spray the suctioned air toward the transfer roller.
- 10.** The steam-blocking apparatus of claim **9**, wherein the air-curtain includes:
a case having an inlet formed at a side facing the width-measuring part and an outlet formed at a side facing the transfer roller;
a fan rotatably installed within the case; and
a fan motor disposed within the case and configured to rotate the fan.
- 11.** The steam-blocking apparatus of claim **8**, further comprising:
an elevating part coupled to the shield and configured to lift or lower the shield; and
a controller configured to operate the elevating part.
- 12.** The steam-blocking apparatus of claim **11**, wherein the elevating part includes:
a driving motor fixed to an external device;
a rotating gear connected to the driving motor and rotated using power provided from the driving motor;
a rack gear engaged with the rotating gear and lifted or lowered by the rotation of the rotating gear; and
a connection plate having one side coupled to the rack gear and the other side coupled to the shield.
- 13.** The steam-blocking apparatus of claim **12**, further comprising:
a displacement sensor installed on the connection plate and configured to sense a distance from the material, wherein the controller is configured to operate the driving motor based on the distance from the material, measured by the displacement sensor.
- 14.** The steam-blocking apparatus of claim **13**, wherein the shield includes:
a body fixed to the connection plate; and
an air-curtain rotatably coupled to a bottom of the body and configured to suction air in the width-measuring part and spray the suctioned air toward the transfer roller.

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