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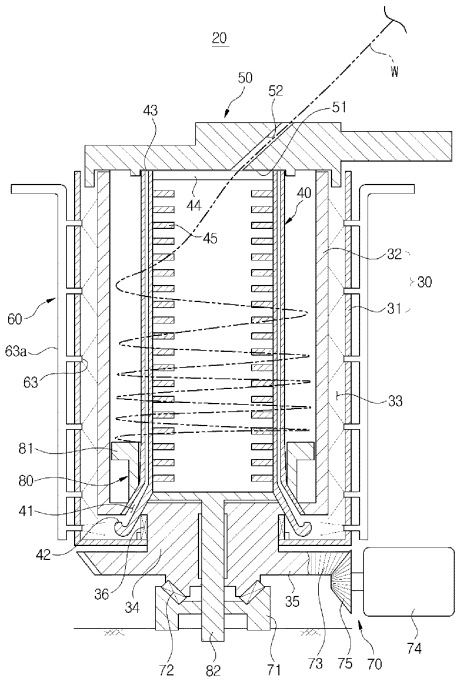
(54) WIRE ROD WINDING DEVICE AND WIRE ROD MANUFACTURING APPARATUS COMPRISING SAME

(57) Disclosed is a wire rod winding device. The wire rod winding device according to an embodiment of the present disclosure comprises: a drum unit including an outer drum and an inner drum spaced apart from the outer drum and rotated by a drive unit; a dry ice supply unit configured to supply dry ice pellets into a chamber formed between the outer drum and the inner drum, and a fork pin unit connected to the inner drum at one side to be rotated integrally with the inner drum and spaced apart from the inner side of the inner drum at the other side to wind a wire rod thereon, wherein the fork pin unit includes a flow channel hole having an inlet formed at one end thereof to communicate with the chamber and an outlet formed at the other end thereof to communicate with the inside of the inner drum.

[FIG. 2]



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Description

[Technical Field]

[0001] The present disclosure relates to a wire rod winding device and a wire rod manufacturing apparatus including same.

[Background Art]

[0002] In general, wire rod rolling is a process of obtaining a wire rod coil having a desired size by heating billets, which are manufactured in a steel making process or a billet making process, to a state suitable for hot rolling and gradually reducing cross-sections thereof through a series of rolling processes.

[0003] Since a wire rod manufactured by the wire rod rolling process has a full length of about 500 m to 10 km, it cannot be stored in a straight form, and thus products are obtained in the form of a coil and this process is called winding.

[0004] A winding process is a process of winding the wire rod coil on a cylindrical apparatus called reeler which includes a drum unit constituting the external diameter of the reeler and a fork pin unit constituting the internal diameter, and the wire rod coil is wound in a space therebetween.

[0005] In addition, in the case where the reeler rotates to wind the wire rod coil, the fork pin unit coupled to the bottom of the drum unit and extending upward eccentrically rotates because the upper end thereof, as a free end, shakes during rotation. Therefore, the fork pin unit causes friction with the wire rod coil, thereby causing problems such as scratches on the wire rod coil.

[0006] Also, in the reeler, while a preceding portion of the wire rod entering in an earlier stage of the winding process is wound at a lower portion of the drum unit, a following portion of the wire rod entering in a later stage of the winding process is wound at an upper portion of the drum unit. Thus, there may be a temperature difference between the upper portion and the lower portion of the wire rod coil due to convection heat loss at an upper portion of the drum unit with an open top.

[0007] Due to the difference in cooling rate between positions of the wire rod coil caused by the amount of heat loss inside the reeler, problems may occur in tensile strength of the wire rod coil and microstructural quality.

[Disclosure]

[Technical Problem]

[0008] Embodiments of the present disclosure provide a wire rod winding device capable of simplifying complex structural problems occurring in the case of using cooling water to cool the wire rod winding device and preventing quality deterioration caused while winding the wire rod coil, and a wire rod manufacturing apparatus including same.

[Technical Solution]

[0009] In accordance with an aspect of the present disclosure, a wire rod winding device includes: a drum unit including an outer drum and an inner drum spaced apart from the outer drum and rotated by a drive unit; a dry ice supply unit configured to supply dry ice pellets into a chamber formed between the outer drum and the inner drum; and a fork pin unit connected with the inner drum at one side for integral rotation with the inner drum and spaced apart from the inside of the inner drum at the other side to wind a wire rod, wherein the fork pin unit has a flow channel hole having an inlet communicating with the chamber at one end and an outlet communicating with the inside of the inner drum at the other end.

[0010] A shaft of the inner drum rotated by the drive unit may be coupled to the outer drum in a penetrating state, and the dry ice supply unit may include at least one spray nozzle to spray dry ice pellets toward a shaft support between the shaft of the inner drum and the outer drum.

[0011] The wire rod winding device may further include a cover unit covering the top of the drum unit and having a guide hole guiding introduction of the wire rod into a space between the inner drum and the fork pin unit.

[0012] The cover unit may have an air discharge flow channel communicating with the outlet of the fork pin unit to discharge gas sublimated from the dry ice to the outside.

[0013] The wire rod winding device may further include a suction device connected to the outlet of the air discharge flow channel to provide a suction force to the flow channel hole through the air discharge flow channel.

[0014] The suction device may include a suction hose connected to the outlet of the air discharge flow channel and a suction fan connected to the suction hose to provide a suction force thereto.

[0015] The dry ice supply unit may include a pellet supplier configured to store and discharge dry ice, a compressed air supplier configured to provide compressed air to deliver dry ice pellets discharged from the pellet supplier, and a plurality of nozzles configured to spray the dry ice pellets delivered by the compressed air into the chamber.

[0016] The dry ice supply unit may include a liquefied carbon dioxide supplier configured to supply liquefied carbon dioxide, an adiabatic expansion unit configured to adiabatically expand the liquefied carbon dioxide received from the liquefied carbon dioxide supplier, a compressed air supplier configured to provide compressed air for delivering dry ice pellets generated in the adiabatic expansion unit, and a plurality of spray nozzles configured to spray dry ice pellets delivered by the compressed air into the chamber.

[0017] A heat dissipation plate may be provided on the bottom of the cover unit to discharge heat of the upper

portion of the drum unit to the outside.

[0018] The heat dissipation plate may include a lower conduction part disposed at the bottom surface of the cover unit, an upper emission part disposed at the top surface of the cover unit and exposed to external air, and a heat transfer part connecting the lower conduction part with the upper emission part.

[0019] The lower conduction part may have an anti-eccentric groove accommodating the upper end of the fork pin unit.

[0020] The wire rod winding device may further include a support to support the wire rod at the inner side of the inner drum and including a cooling flow channel formed therein, wherein the cooling flow channel communicates with the chamber through a hole formed in the inner drum

[0021] In accordance with another aspect of the present disclosure, a wire rod manufacturing apparatus includes: a heating furnace configured to heat provided billets; a rolling unit located at an outlet side of the heating furnace and configured to roll the heated billets; and the wire rod winding device disposed at an outlet side of the rolling unit and configured to wind a wire rod prepared by rolling the billets.

[Advantageous Effects]

[0022] According to the embodiments of the present disclosure, a structure for cooling the wire rod winding device may be simplified, and surface defects caused on the winding apparatus and the wire rod coil and quality deviation of the wire rod coil caused by a temperature difference between positions of the wire rod coil wound on the winding apparatus may be reduced.

[Description of Drawings]

[0023]

FIG. 1 schematically illustrates a wire rod manufacturing apparatus according to an embodiment of the present disclosure.

FIG. 2 is a cross-sectional view illustrating a wire rod winding device according to an embodiment of the present disclosure.

FIG. 3 is a perspective view illustrating a fork pin unit according to an embodiment of the present disclosure.

FIG. 4 illustrates a dry ice supply unit according to an embodiment of the present disclosure.

FIG. 5 illustrates a part of a shaft support according to an embodiment of the present disclosure.

FIG. 6 shows a dry ice supply unit according to another embodiment of the present disclosure.

FIG. 7 illustrates a suction device of a cover unit according to an embodiment of the present disclosure.

FIG. 8 shows a cover unit according to another embodiment of the present disclosure.

FIG. 9 is a cross-sectional view illustrating a support according to an embodiment of the present disclosure.

[Modes of the Invention]

[0024] Hereinafter, embodiments of the present disclosure will be described in detail with reference to the accompanying drawings. These embodiments are provided to fully convey the concept of the present disclosure to those of ordinary skill in the art. The present disclosure may, however, be embodied in many different forms and should not be construed as limited to the exemplary embodiments set forth herein. In the drawings, parts unrelated to the descriptions are omitted for clear description of the disclosure and widths, lengths, thicknesses, and the like of elements may be exaggerated for clarity. Throughout the specification, like reference numerals denote like elements.

[0025] FIG. 1 schematically illustrates a wire rod manufacturing apparatus according to an embodiment of the present disclosure.

[0026] Referring to FIG. 1, a wire rod manufacturing apparatus 10 of the embodiment includes a heating furnace 11 configured to heat provided billets B, a rolling unit 12 located at an outlet side of the heating furnace 11 and configured to roll the heated billets B, and a wire rod winding device 20 located at an outlet side of the rolling unit 12 and configured to wind the rolled wire rod W.

[0027] As such, a wire rod rolling process used to manufacture wire rods W by the wire rod manufacturing apparatus 10 is performed by heating billets B, which are manufactured in a steel making process or a billet making process, in the heating furnace 11 to a state suitable for hot rolling, obtaining a wire rod coil by gradually reducing cross-sections thereof to a desired size through a series of rolling processes in the rolling unit 12 including a rough mill and a finishing mill, transferring the wire rod coil to the wire rod winding device 20, and storing the coil in a wound state.

[0028] FIG. 2 is a cross-sectional view illustrating a wire rod winding device according to an embodiment of the present disclosure. FIG. 3 is a perspective view illustrating a fork pin unit according to an embodiment of the present disclosure.

[0029] FIG. 4 illustrates a dry ice supply unit according to an embodiment of the present disclosure.

[0030] Referring to FIGS. 2 to 4, the wire rod winding device 20 includes a drum unit 30 having a double-drum structure, a fork pin unit 40 disposed inside the drum unit 30, a cover unit 50 to cover the top of the drum unit 30, a dry ice supply unit 60 configured to supply dry ice pellets to cool the drum unit 30, a drive unit 70 configured to rotate the drum unit 30, and a lifting unit 80 configured to discharge the stored wire rod to the outside.

[0031] The drum unit 30 may have a container shape with an open top and a double-drum structure consisting of an outer drum 31 and an inner drum 32.

[0032] The outer drum 31 may be spaced apart from the outer surface of the inner drum 32 at a predetermined interval in a shape surrounding the outer periphery of the outer surface of the inner drum 32. Dry ice pellets, which are supplied by the dry ice supply unit 60, are sprayed into a chamber 33 that is a space formed between the outer drum 31 and the inner drum 32.

[0033] The inner drum 32 may be rotated by the drive unit 70. A shaft 34 connected to the drive unit 70 is provided at the lower end of the inner drum 32. The shaft 34 may penetrate the outer drum 31 and extend downward from the bottom of the outer drum 31.

[0034] The lower end of the shaft 34 may be rotatably supported by a mount 71 supported by the floor. A bearing member 72 may be installed between the mount 71 and the lower end of the shaft 34 for smooth rotation of the shaft 34. The bearing member 72 includes a thrust bearing to reduce frictional resistance during rotation while supporting an axial load.

[0035] A flange 35 extending outward in a radial direction is provided on the outer surface of the shaft 34 exposed to the outside of the outer drum 31 such that a driven bevel gear 73 is coupled thereto, and the driven bevel gear 73 may rotate in an engaged state with a drive bevel gear 75 coupled to a shaft of the drive motor 74.

[0036] A shaft support 36 may be provided on the outer surface of the shaft 34 penetrating the outer drum 31 to reduce frictional resistance while the shaft 34 rotates. The shaft support 36 includes a bearing member such as sleeve bearing and rolling bearing to reduce frictional resistance of a member rotating on the other side.

[0037] The fork pin unit 40 may be formed in the form of a plurality of vertically extending rods penetrating the bottom of the inner drum 32 and hollow flow channel holes 41 may be vertically formed inside the fork pin unit 40.

[0038] The fork pin unit 40 integrally coupled to the inner drum 32 may rotate together with the inner drum 32 to guide winding of the wire rod. The wire rod introduced into the inner drum 32 may be wound and stored between the inner drum 32 and the fork pin unit 40.

[0039] Via the flow channel holes 41 formed in the fork pin unit 40, the chamber 33 may communicate with the inside of the inner drum 32. An open inlet 42 formed at the lower end of the flow channel hole 41 may be located inside the chamber 33, and an open outlet 43 formed at the upper end of the flow channel hole 41 may be located around the upper end of the inner drum 32.

[0040] The inlet 42 of the flow channel hole 41 serves as an air suction port to suck dry ice pellets sprayed into the chamber 22 into the flow channel hole 41, and the outlet 43 of the flow channel hole 41 serves as an air discharge port to discharge sublimated carbon dioxide gas that has passed along the flow channel hole 41.

[0041] The upper end of the fork pin unit 40 formed in the form of the plurality of rods may be connected by a connection rim 44. Link coupling taps, bolting coupling taps, or the like for coupling with the fork pin unit 40 may be formed at the connection rim 44 in a circumferential direction.

[0042] Also, a plurality of cooling fins 45 spaced apart from each other at predetermined intervals may be formed on the fork pin unit 40 in the vertical direction.

[0043] The cover unit 50 may cover the open top of the inner drum 32 to prevent heat loss from the top of the inner drum 32 by convection while winding the wire rod. The cover unit 50 may be configured as a moving heat-retaining cover.

[0044] An anti-eccentric groove 51 to restrain eccentric rotation while the fork pin unit 40 rotates may be formed on the bottom surface of the cover unit 50 and the fork pin unit 40 may rotate in a state where the upper end of the fork pin unit 40 is accommodated in the anti-eccentric groove 51.

[0045] The cover unit 50 may have a guide hole 52 for introducing the wire rod into the inner drum 32 while winding the wire rod. The guide hole 52 may be formed in an inclined direction corresponding to an entry direction of the wire rod such that the wire rod is stored in the inner drum 32 in a wound state.

[0046] The dry ice supply unit 60 supplies dry ice particles into the chamber 33 formed between the outer drum 31 and the inner drum 32 and includes a compressed air supplier 61, a pellet supplier 62, and a plurality of spray nozzles 63.

[0047] The compressed air supplier 61, the pellet supplier 62, and the plurality of spray nozzles 63 may be connected to each other via a dry ice supply line 64.

[0048] The compressed air supplier 61 may include an air compressor 61a and a receiver tank 61b. The air compressor 61a may include a pump to generate compressed air, and the compressed air generated in the air compressor 61a may be supplied to the receiver tank 61b.

[0049] The receiver tank 61b may perform a function of a buffer by temporarily storing the compressed air supplied from the air compressor 61a and may provide the stably compressed air toward the pellet supplier 62.

[0050] The pellet supplier 62 provides dry ice pellets to the dry ice supply line 64 and includes a hopper 52a to store dry ice, and a feeder 62b to provide dry ice received from the hopper 62a to the dry ice supply line 64.

[0051] The feeder 62b may include a screw conveyor or a rotating disk type for crushing dry ice into pellets, and the dry ice pellets provided from the feeder 62b to the dry ice supply line 64 may be transported to the plurality of spray nozzles 63 by the compressed air supplied by the compressed air supplier 61.

[0052] The plurality of spray nozzles 63 may be connected to the dry ice supply line 64 and disposed at a vertically extending nozzle header 63a to be spaced apart from each other at predetermined intervals.

[0053] The plurality of spray nozzles 63 may be configured to spray dry ice pellets into the chamber 33 and spaced apart from each other at predetermined intervals along the circumferential direction or a height direction

of the drum unit 30.

[0054] Referring to FIG. 5, among the plurality of spray nozzles 63, at least one spray nozzle 63b may be configured to selectively spray dry ice pellets toward the shaft support 36. The dry ice pellets sprayed to the shaft support 36 rapidly lower the temperature of contaminant particles adhered to the shaft support 36, and cracks are caused in the contaminant particles whose adhesion has been decreased by physical impact and rapid cooling, so that the contaminant particles are separated from the surface of the shaft support 36. Therefore, non-smooth rotation of the drum unit 30 caused by the contaminant particles adhered to the shaft support 36 may be prevented.

[0055] FIG. 6 shows a dry ice supply unit according to another embodiment of the present disclosure. Hereinafter, the same reference numerals are assigned to elements having substantially same function, and detailed descriptions thereof will be omitted.

[0056] Referring to FIG. 6, a dry ice supply unit 60 includes a liquefied carbon dioxide supplier 65 configured to supply liquefied carbon dioxide, an adiabatic expansion unit 66 configured to adiabatically expand the liquefied carbon dioxide received from the liquefied carbon dioxide supplier 65, a compressed air supplier 61 configured to provide compressed air that delivers dry ice pellets generated in the adiabatic expansion unit 66, and a plurality of spray nozzles 63 to spray dry ice pellets delivered by the compressed air into the chamber 33.

while the liquefied carbon dioxide supplied by the liquefied carbon dioxide supplier 65 is adiabatically expanded in the adiabatic expansion unit 66, dry ice pellets are generated, and the generated dry ice pellets may be supplied into the chamber 33 through a plurality of spray nozzles 63 using the compressed air generated in the compressed air supplier 61.

[0057] Through this configuration, in the process of winding the wire rod performed by the wire rod winding device 20, the dry ice pellets sprayed via the plurality of spray nozzles 63 are introduced into the chamber 33 and then introduced into the flow channel hole 41 of the fork pin unit 40 through the inlet 42 of the fork pin unit 40 communicating with the chamber 33.

[0058] The dry ice pellets introduced into the chamber 33 and the flow channel hole 41 instantly lower the temperature of the drum unit 30 and the fork pin unit 40 while sublimating and then are discharged through the outlet 43 of the fork pin unit 40. Thereby, in comparison with a case of using cooling water for cooling the drum unit 30 and the fork pin unit 40, there is no need to install a separate structure to discharge cooling water and a sealing structure to prevent damage to peripheral parts caused by leakage of the cooling water.

[0059] Hereinafter, wire rod winding devices according to various embodiments of the present disclosure will be described. In the following descriptions, the same reference numerals will be assigned to elements having substantially same functions, and detailed descriptions thereof will be omitted.

[0060] FIG. 7 illustrates a suction device connected to a cover unit according to an embodiment of the present disclosure. Referring to FIG. 7, a suction device 90 providing a suction force for smoothly sucking the dry ice pellets filled in the chamber 33 toward the flow channel hole 41 may be connected to the cover unit 50 of the present embodiment.

[0061] The suction device 90 is intended to induce an increase in the amount of the dry ice pellets introduced into the flow channel hole 41 even at a high rotation speed of the drum unit 30 and includes an air discharge flow channel 91 formed at the cover unit 50, a suction fan 92 providing a suction force, and a suction hose 93 connecting the suction fan 92 with the air discharge flow channel 91.

[0062] An inlet 91a of the air discharge flow channel 91 may be installed to communicate with the outlet 43 of the fork pin unit 40, and an outlet 91b of the air discharge flow channel 91 may be connected to the suction hose 93.

[0063] The inlet 91a of the air discharge flow channel 91 may be formed in a circular ring shape, and the outlet 43 and the connection rim 44 disposed at the upper end of the fork pin unit 40 may be in close contact with the inlet 91a. In this regard, the inlet 91a of the air discharge flow channel 91 may perform the function of the anti-eccentric groove described above.

[0064] FIG. 8 shows a cover unit according to another embodiment of the present disclosure.

[0065] Referring to FIG. 8, a heat dissipation plate 100 may be provided on the bottom of the cover unit 50 to discharge heat of the upper portion of the drum unit 30 to the outside.

[0066] While the wire rod is wound on the drum unit 30, a temperature of a portion of the wire rod wound later at an upper portion of the drum unit 30 may be relatively higher than that of the wire rod wound earlier at a lower portion of the drum unit 30, and thus the heat dissipation plate 100 rapidly discharges heat of the upper portion of the drum unit 30 out of the cover unit 50. Therefore, while the wire rod is wound, a temperature deviation in the vertical direction inside the drum unit 30 may be reduced, thereby preventing deterioration in quality of the wire rod.

[0067] The heat dissipation plate 100 may be formed of a metallic material having excellent thermal conductivity such as aluminum. The heat dissipation plate 100 includes a lower conduction part 101 disposed at the bottom surface of the cover unit 50 and receiving heat from the upper portion of the inside of the drum unit 30, an upper emission part 102 disposed at the top surface of the cover unit 50 to be exposed to the outside to emit heat, and a heat transfer part 103 connecting the upper emission part 102 with the lower conduction part 101 to transfer heat received from the lower conduction part 101 to the upper emission part 102.

[0068] Heat dissipation protrusions 104 may be disposed on the upper emission part 102 to improve heat dissipation property by enlarging a contact area with ex-

ternal air.

[0069] Meanwhile, in the case where the cover unit 50 is provided with the heat dissipation plate 100, the lower conduction part 101 may have an anti-eccentric groove 51 to accommodate the upper end of the fork pin unit 40.

[0070] Through this configuration, heat of the upper portion of the inside of the drum unit 30 may be discharged to the outside through the heat dissipation protrusions 104 after being conducted to the upper emission part 102 through the lower conduction part 101 and the heat transfer part 103.

[0071] Referring back to FIG. 2, the lifting unit 80 is intended to guide mounting of the wound wire rod in the inner drum 32 or discharge the stored wire rod coil to the outside and includes a support 81 to support the wire rod and an elevating member 82 to move the support 81 upward and downward. The elevating member 82 may move upward and downward in association with a hydraulic or pneumatic cylinder that extends and retracts.

[0072] Meanwhile, referring to FIG. 9. The cooling flow channel 83 communicating with the chamber 33 may be formed in the support 81. The cooling flow channel 83 may communicate with the chamber 33 through a hole 37 formed in the inner drum 32.

[0073] The hole 37 formed in the inner drum 32 may be located to communicate with the cooling flow channel 83 of the support 81 when the support 81 is located at the lower end of the inner drum 32, and the support 81 may be cooled as dry ice pellets introduced into the channel 33 therethrough are supplied into the cooling flow channel 83 and sublimated.

[0074] Meanwhile, although one hole 37 is formed in the inner drum 32 in the present embodiment, a plurality of holes may be formed at appropriate positions such that the cooling flow channel 83 communicates with the chamber 33 when the support 81 moves to mount the wire rod, and the plurality of holes may also be configured to be selectively opened and closed.

[0075] While the present disclosure has been particularly described with reference to exemplary embodiments, it should be understood by those of skilled in the art that the scope of the present disclosure is not limited thereby and various changes in form and details may be made without departing from the spirit and scope of the present disclosure.

Claims

1. A wire rod winding device comprising:

a drum unit comprising an outer drum and an inner drum spaced apart from the outer drum and rotated by a drive unit;
a dry ice supply unit configured to supply dry ice pellets into a chamber formed between the outer drum and the inner drum; and
a fork pin unit connected with the inner drum at one side for integral rotation with the inner drum and spaced apart from the inside of the inner drum at the other side to wind a wire rod,
wherein the fork pin unit has a flow channel hole having an inlet communicating with the chamber at one end and an outlet communicating with the inside of the inner drum at the other end.

2. The wire rod winding device according to claim 1, wherein a shaft of the inner drum rotated by the drive unit is coupled to the outer drum in a penetrating state, and
the dry ice supply unit comprises at least one spray nozzle to spray dry ice pellets toward a shaft support between the shaft of the inner drum and the outer drum.

3. The wire rod winding device according to claim 1, further comprising a cover unit covering the top of the drum unit and having a guide hole guiding introduction of the wire rod into a space between the inner drum and the fork pin unit.

4. The wire rod winding device according to claim 3, wherein the cover unit has an air discharge flow channel communicating with the outlet of the fork pin unit to discharge gas sublimated from the dry ice to the outside.

5. The wire rod winding device according to claim 4, further comprising a suction device connected to the outlet of the air discharge flow channel to provide a suction force to the flow channel hole through the air discharge flow channel.

6. The wire rod winding device according to claim 5, wherein the suction device comprises a suction hose connected to the outlet of the air discharge flow channel and a suction fan connected to the suction hose to provide a suction force thereto.

7. The wire rod winding device according to claim 5, wherein the dry ice supply unit comprises a pellet supplier configured to store and discharge dry ice, a compressed air supplier configured to provide compressed air to deliver dry ice pellets discharged from the pellet supplier, and a plurality of nozzles configured to spray the dry ice pellets delivered by the compressed air into the chamber.

8. The wire rod winding device according to claim 5, wherein the dry ice supply unit comprises a liquefied carbon dioxide supplier configured to supply liquefied carbon dioxide, an adiabatic expansion unit configured to adiabatically expand the liquefied carbon dioxide received from the liquefied carbon dioxide supplier, a compressed air supplier configured to provide compressed air for delivering dry ice pellets

generated in the adiabatic expansion unit, and a plurality of spray nozzles configured to spray dry ice pellets delivered by the compressed air into the chamber.

9. The wire rod winding device according to claim 3, wherein a heat dissipation plate is provided on the bottom of the cover unit to discharge heat of the upper portion of the drum unit to the outside.

10. The wire rod winding device according to claim 9, wherein the heat dissipation plate comprises a lower conduction part disposed at the bottom surface of the cover unit, an upper emission part disposed at the top surface of the cover unit and exposed to external air, and a heat transfer part connecting the lower conduction part with the upper emission part.

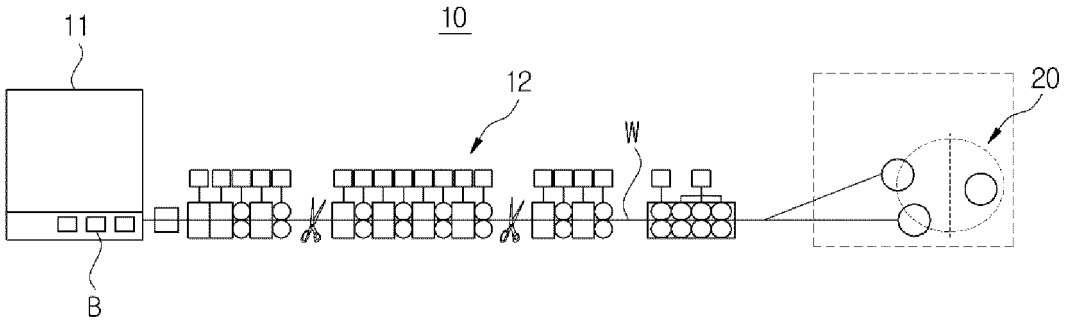
11. The wire rod winding device according to claim 10, wherein the lower conduction part has an anti-eccentric groove accommodating the upper end of the fork pin unit.

12. The wire rod winding device according to claim 1, further comprising a support to support the wire rod at the inner side of the inner drum and including a cooling flow channel formed therein,
wherein the cooling flow channel communicates with the chamber through a hole formed in the inner drum.

13. A wire rod manufacturing apparatus comprising:

a heating furnace configured to heat provided billets;
a rolling unit located at an outlet side of the heating furnace and configured to roll the heated billets; and
the wire rod winding device according to any one of claims 1 to 12 disposed at an outlet side of the rolling unit and configured to wind a wire rod prepared by rolling the billets.

[FIG. 1]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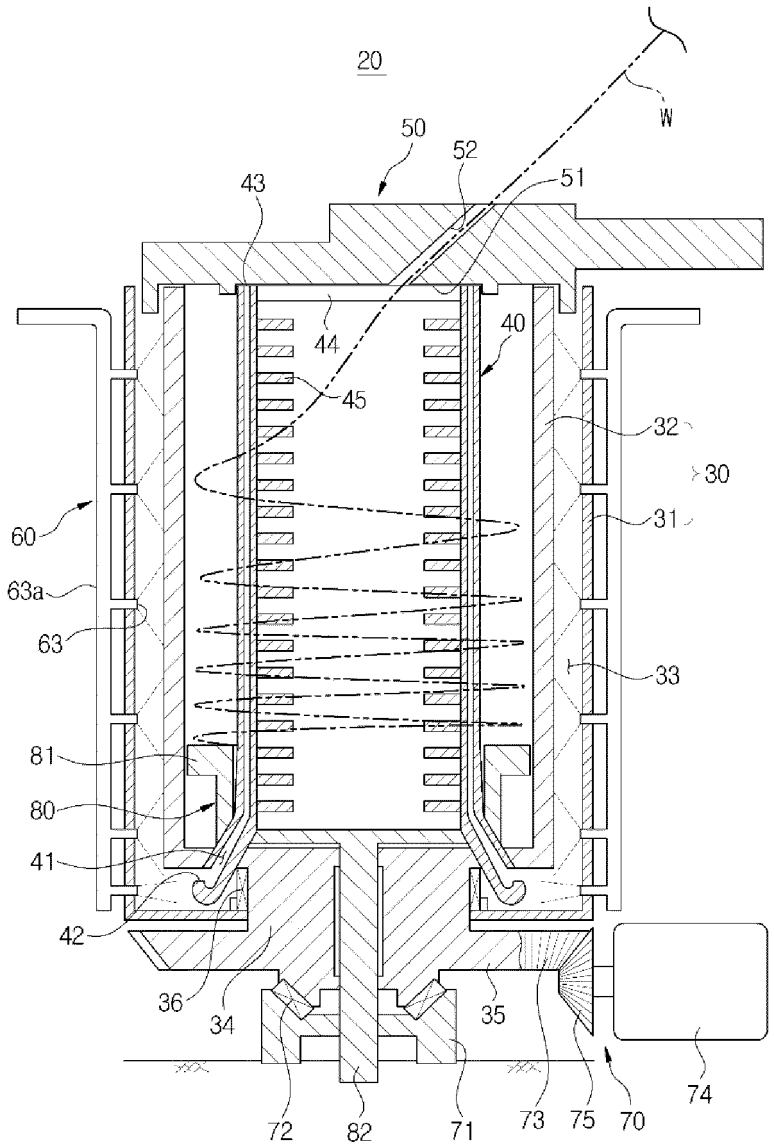
[FIG. 2]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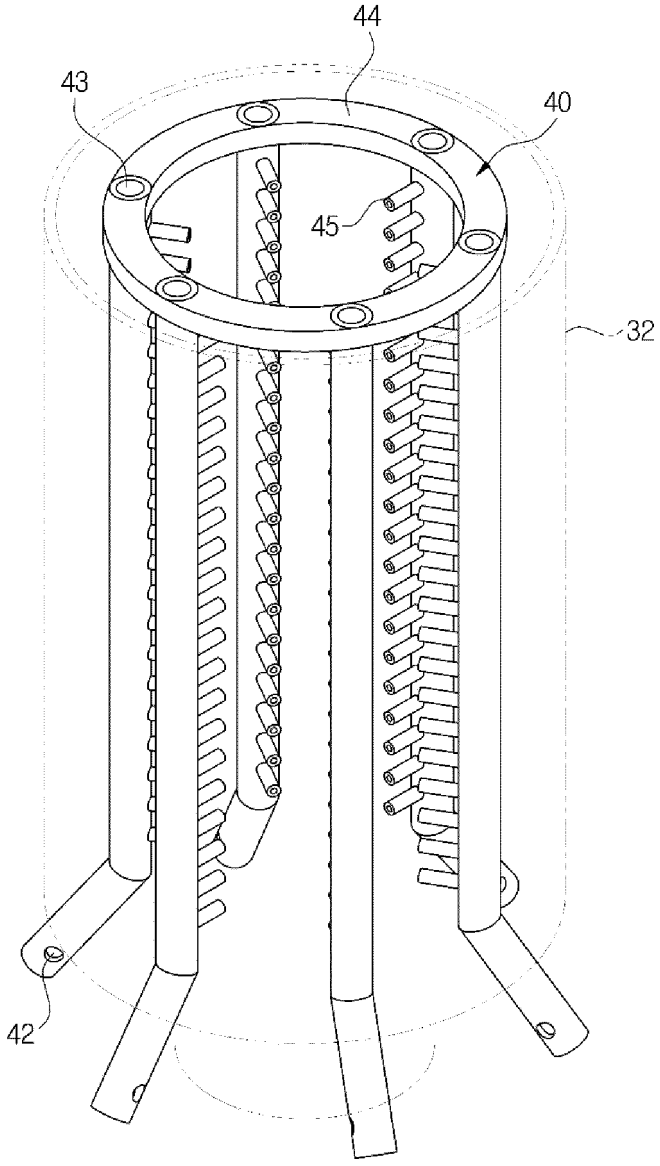
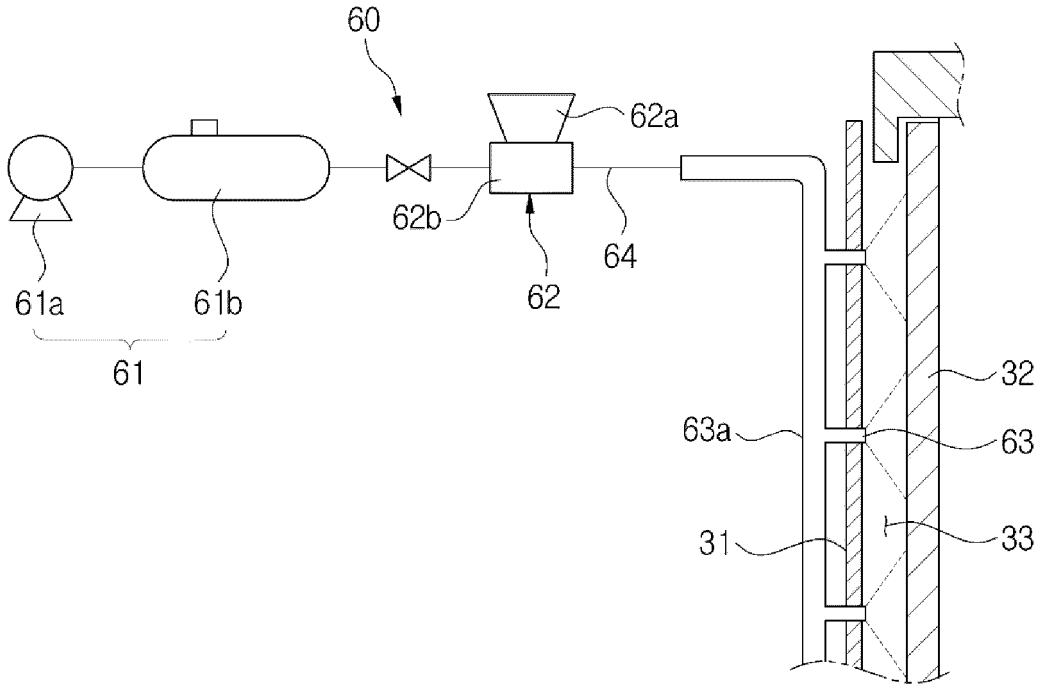
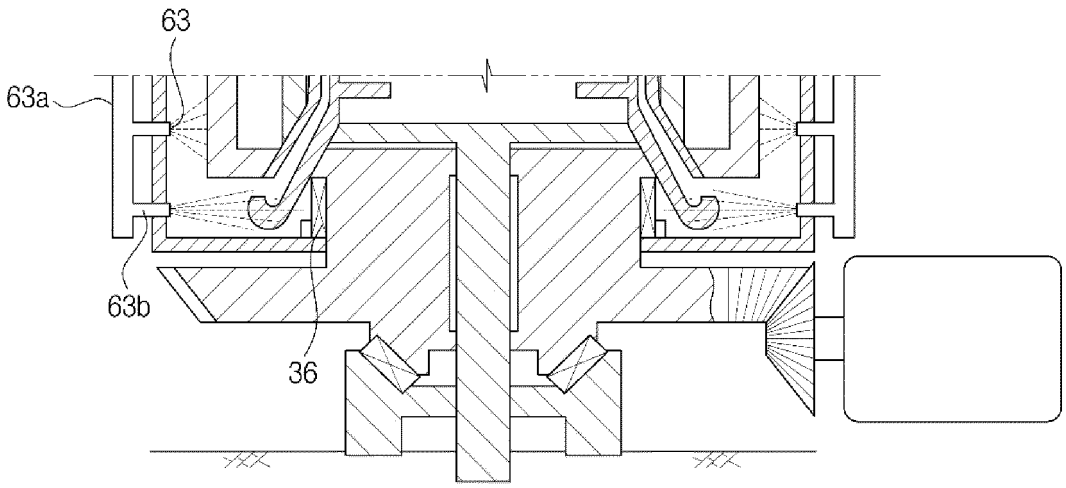
[FIG. 3]



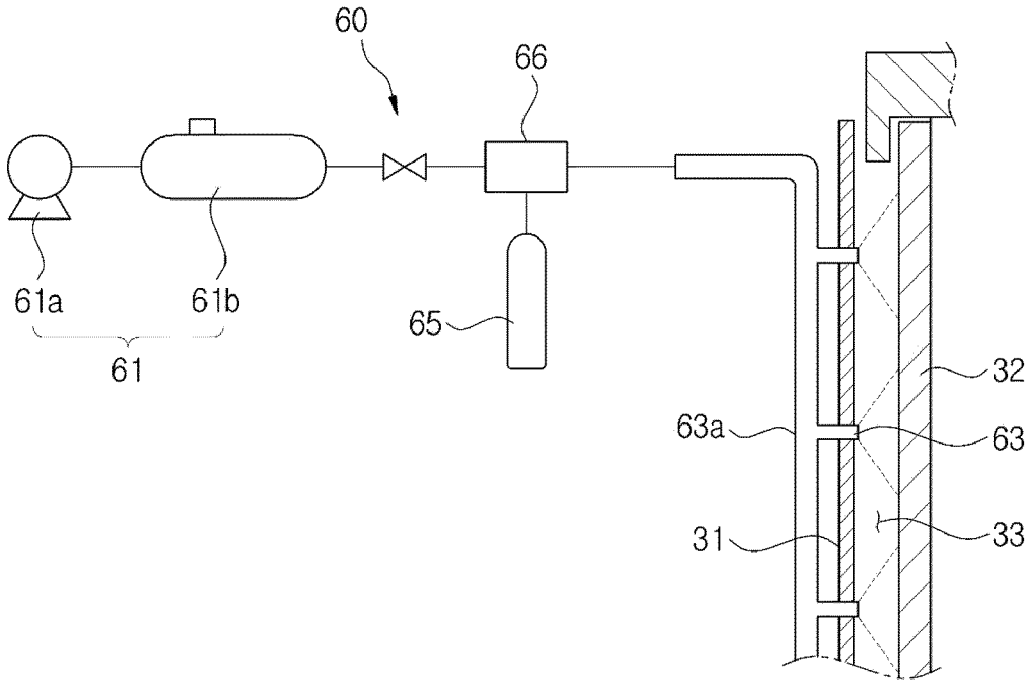
[FIG. 4]



[FIG. 5]



[FIG. 6]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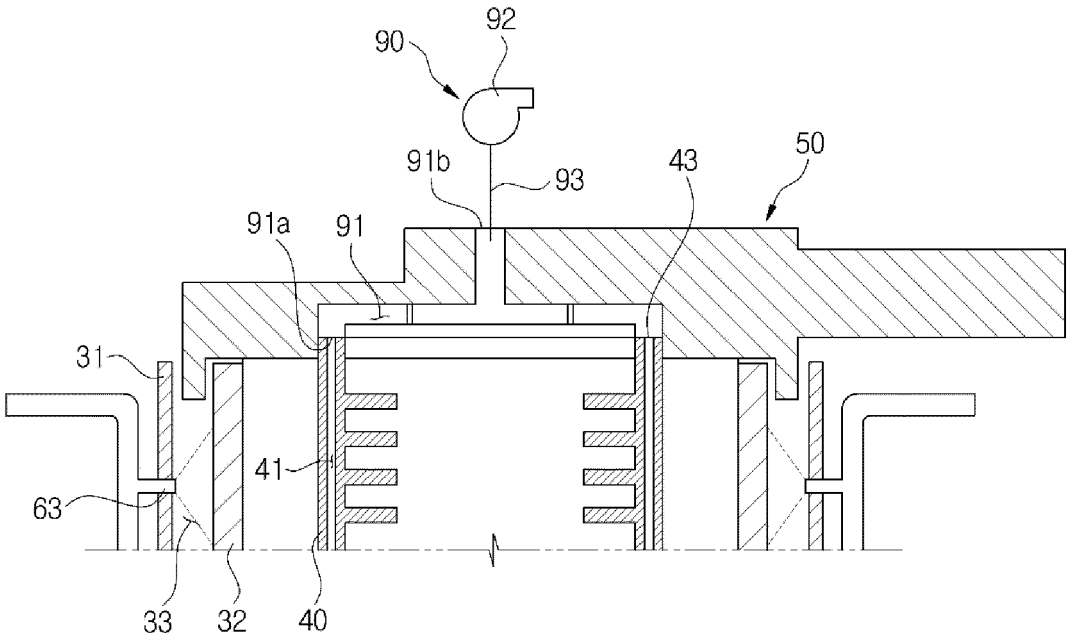
33

[FIG. 7]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91b
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41
63
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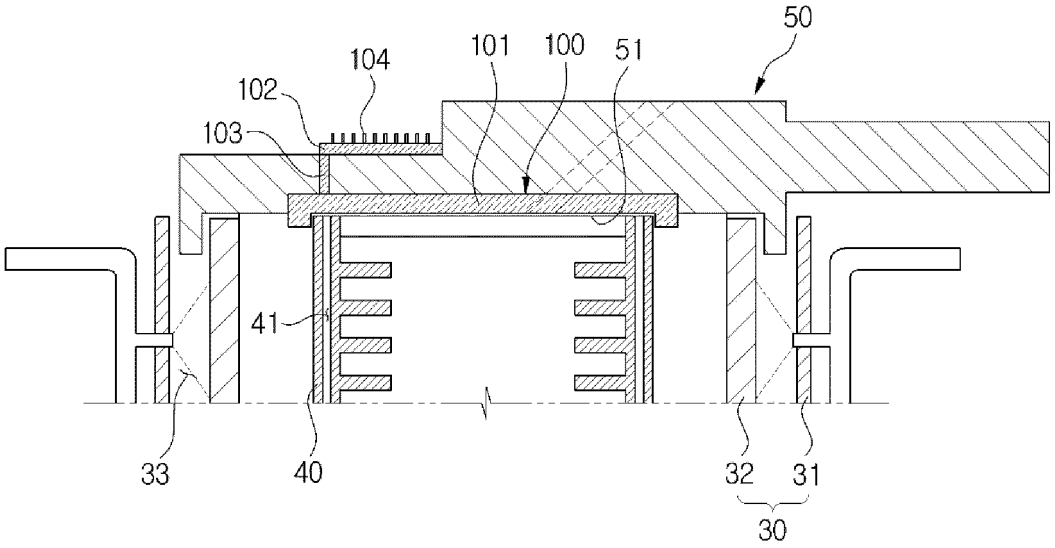
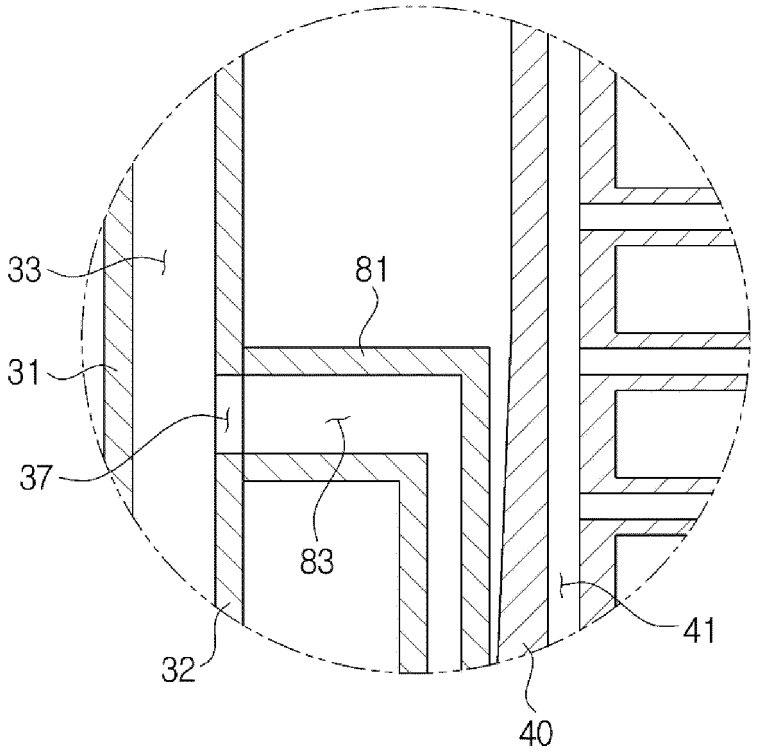
40

[FIG. 8]



[FIG. 9]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2020/016293

A. CLASSIFICATION OF SUBJECT MATTER

B21C 47/04(2006.01)i; **B21C 47/26**(2006.01)i; **F25D 3/12**(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B21C 47/04(2006.01); B21B 45/00(2006.01); B21C 1/02(2006.01); B21C 3/14(2006.01); B21C 47/00(2006.01); B21C 47/24(2006.01); B21C 47/26(2006.01); B21C 47/28(2006.01); C21D 1/64(2006.01); C21D 9/52(2006.01); C21D 9/58(2006.01)

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

Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

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

eKOMPASS (KIPO internal) & keywords: 권취(winding), 챔버(chamber), 드라이아이스(dry ice), 회전(rotation), 유로(flow path), 배기(exhaust), 냉각(cooling)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	KR 10-2098499 B1 (POSCO) 07 April 2020 (2020-04-07)	
X	See paragraphs [0032], [0043]-[0044], [0046], [0058], [0063] and [0076] and figures 1-2 and 4.	1-3,13
A	- -	4-12
Y	See paragraphs [0043]-[0044], [0046] and [0058] and figures 1-2 and 4.	1
	JP 06089412 B2 (NIPPON STEEL CORP.) 09 November 1994 (1994-11-09)	
Y	See page 2.	1
	KR 10-0685047 B1 (POSCO) 20 February 2007 (2007-02-20)	
Y	See paragraph [0038].	1
	KR 10-2011-0129577 A (POSCO) 02 December 2011 (2011-12-02)	
X	See paragraphs [0024]-[0052] and figures 2 and 4a.	1

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 May 2021	**14 May 2021**
Name and mailing address of the ISA/KR **Korean Intellectual Property Office** **Government Complex-Daejeon Building 4, 189 Cheongsa-ro, Seo-gu, Daejeon 35208** Facsimile No. **+82-42-481-8578**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2020/016293

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 20-0275554 Y1 (POSCO) 31 October 2002 (2002-10-31) See claim 1 and figures 2-3.	1-13
A	JP 08-024947 A (ISHIKAWAJIMA HARIMA HEAVY IND. CO., LTD.) 30 January 1996 (1996-01-30) See claim 1 and figures 1-2.	1-13
A	US 4011110 A (BOCKENHOFF et al.) 08 March 1977 (1977-03-08) See column 3, line 44 - column 6, line 5 and figures 1-2.	1-13

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2020/016293

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
KR	10-2098499	B1	07 April 2020	None			
JP	06089412	B2	09 November 1994	JP	01-255624	A	12 October 1989
KR	10-0685047	B1	20 February 2007	None			
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				NL	7508652	A	27 January 1976
				SE	7508489	A	26 January 1976

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