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(54) **HOT-ROLLING ONLINE MOVABLE THERMAL INSULATION HEAT TREATMENT PROCESS, AND HEAT TREATMENT LINE**

INLINE-VERFAHREN ZUR WÄRMEBEHANDLUNG MIT MOBILER WÄRMEDÄMMUNG DURCH HEISSWALZEN UND WÄRMEBEHANDLUNGSLINIE

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Description

Technical Field

[0001] The present invention relates to a hot-rolling and heat treatment process, particularly to a hot-rolling on-line thermal insulation heat treatment process and a heat treatment line.

Background Art

[0002] In traditional hot rolling production processes, due to the complex composition design and strengthening mechanism of hot-rolled and cold-rolled high-strength steel, uneven cooling and excessively fast cooling after rolling or coiling have a negative influence on the performances of finished products, resulting in such problems as fluctuation of strip steel performances, degradation of plate shape, etc. In order to solve these problems, after coiling, hot coils are usually sent to a hot-rolled steel finishing warehouse to receive collective slow cooling with the aid of thermal insulation (using thermal insulation walls or thermal insulation pits, etc) or off-line heat treatment (using a roller hearth furnace or a bell furnace, etc.) to alleviate the influence. However, this leads to increased manufacturing cost, prolonged manufacturing cycle, among other problems. Moreover, some of the means cannot fully achieve the purpose of improving performances and plate shape quality.

[0003] Conventional methods for post-coiling heat treatment of hot coils include:

1) after coiling, hot coils are sent to a finishing warehouse for slow cooling treatment using thermal insulation pits or thermal insulation walls;
2) after coiling, hot coils are sent to a finishing warehouse where they are stacked for collective slow cooling, after which plates are cut out using a decoiler set, and then tempered in a roller hearth furnace;
3) after coiling, hot coils are sent to a cold-rolling stage, and then annealed in a bell furnace for cold-rolled steel.

[0004] The original process flow is: heating - rolling - laminar cooling - coiling - off-line heat treatment (in a thermal insulation pit or a heat treatment furnace, etc.).

Disadvantages of the prior art:

[0005] In the case where hot coils are sent to a finishing warehouse after coiling, and then slowly cooled using thermal insulation pits or thermal insulation walls, it generally takes 30-120 minutes for the hot coils to be transported into the warehouse after coiling, during which time uneven cooling of the inner cycle, outer cycle and sides of the strip steel has already occurred due to the fast cooling rate of the hot coils in air. In addition, there is no heat source in the thermal insulation pits or walls for providing heat, and thus the slow cooling treatment actually improves the performances and plate shape quality of the strip steel to a very limited extent.

[0006] In the case of tempering treatment using a roller hearth furnace or annealing treatment using a bell furnace, uniform heat treatment of strip steel may be realized, but a huge one-time project investment is required. Moreover, the strip steel needs to be reheated, which leads to a significant increase in manufacturing cost and a prolonged manufacturing cycle of the product.

[0007] At present, other steel plants at home and abroad usually treat hot coils by collective slow cooling with the aid of thermal insulation (using thermal insulation walls or thermal insulation pits, etc.) in a hot-rolled steel finishing warehouse or off-line heat treatment (using a roller hearth furnace or a bell furnace, etc.).

[0008] For example, CN 102 815 491 A discloses a "carrier roller-tray type metal strip coil transport device", wherein a transport chain tray is used to roll up and transport a steel coil after coiling. This device comprises a fixed saddle just for transporting a steel coil. It cannot perform on-line thermal insulation of the steel coil during transportation.

[0009] CN 107 470 377 A discloses an "on-line thermal insulation slow cooling device" which only has thermal insulation effect. Due to incomplete sealing of its bottom structure, the thermal insulation effect is not good for steel coils.

[0010] JP 2010 094710 A discloses a "tunnel-type thermal insulation enclosure", wherein special thermal insulation pits and the like are added to the production line, which generally results in high cost. Moreover, it takes a long period of time to retrofit the production line, and thus normal production will be affected.

[0011] KR 1 589 913 B1 discloses a "mobile tunnel thermal insulation enclosure". Although movement and thermal insulation are achieved at the same time, the overall mobile equipment is contained in a thermal insulation chamber, and thus the service life of the equipment is shortened. Independent thermal insulation of individual objects and a perfect combination of a thermal insulation enclosure with a transport line cannot be achieved.

[0012] CN 101 413 051 B discloses a "deep processing system for hot-rolled strip steel", wherein a thermal insulation tunnel structure is used, but the overall mobile equipment is contained in a thermal insulation chamber, and thus the service life of the equipment is shortened.

[0013] The following problems exist in the above prior art:

(1) The most prominent problem of a hot-rolling thermal insulation device is that the interval between coiling of strip steel and entry of a steel coil into the insulation device is so long that metallographic structure transformation of the strip steel has already occurred or has been completed. The effect of off-line slow cooling in improving hot coil performances cannot meet the quality requirements for high-strength

steel. It will take as long as 20-30 minutes to hoist and transfer the hot coil into a thermal insulation enclosure, such that the air cooling time of the steel coil is too long, which affects the thermal insulation effect and material properties.

(2) The cost of adding special thermal insulation pits, thermal insulation furnaces, bell furnaces, heat treatment lines and the like to a production line is generally high. Moreover, it takes a long period of time to retrofit the production line, and thus normal production will be affected. In addition, there is a problem that the thermal insulation effect is not good (i.e. temperature drops fast).

(3) Thermal insulation enclosures are nearly all in off-line mode (the thermal insulation devices are statically positioned on a coiling platform), and transportation of steel coils disrupts the normal production rhythm of a production line. The production capacity of the rolled steel production line is affected, and bulk production is practically difficult.

(4) Semi-closed "tunnel" insulation using a transport chain or the thermal insulation technology using a vertical transportation mode has the disadvantages of, inter alia, insufficient insulating time and poor thermal insulation effect of steel coils in large-scale production, and thus they are very difficult to be put into practice.

Summary

[0014] The invention is defined in the appended claims. An object of the present invention is to provide a hot-rolling on-line movable thermal insulation heat treatment process and a heat treatment line, wherein the coiling process temperature for a hot coil is effectively exploited to efficiently perform thermal insulation heat treatment on the hot coil at the earliest time. The thermally insulated hot coil moves on-line along with a thermal insulation device to ensure meeting differentiated heat treatment process requirements. Not only product performances can be improved effectively, but also one-time investment is low. The needs of high-speed large-scale production can be satisfied, and energy can be saved.

[0015] To achieve the above object, the technical solution of the present invention is provided by a hot-rolling on-line movable thermal insulation heat treatment process as defined in claim 1 or a hot-rolling on-line movable thermal insulation heat treatment line as defined in claim 6. Further improvements are subject to the dependent claims.

[0016] In the hot-rolling on-line movable thermal insulation heat treatment line of the present invention:

After the strip steel is coiled, the steel coil transport cart transports the steel coil to the tray, and then the thermal insulation device is placed on the tray to insulate the steel coil at the earliest time.

[0017] The thermal insulation enclosure and the steel coil move normally along the transport chain roller bed with no influence on the production operation of succeeding steel coils, while heat treatment is implemented during transportation.

[0018] Transport cart lateral transmission roller bed device: this device transfers an unloaded transport cart device bearing no thermal insulation enclosure from a back-haul transport chain roller bed to the heat treatment transport chain roller bed to realize transmission of the transport cart device to ensure that the transport cart can continue to receive another hot-rolled steel coil coming from the coiling station.

[0019] The thermal insulation enclosure hoisting device lifts the thermal insulation enclosure from the transport cart device that carries the thermal insulation enclosure and moves on the back-haul transport chain roller bed, and then transfers the thermal insulation enclosure to the heat treatment transport chain roller bed to wait for next operation. When the hot-rolled steel that has been coiled is placed on the transport cart device, a thermal insulation enclosure up-transfer hoisting device automatically places the thermal insulation enclosure on the transport cart device to achieve thermal insulation of the hot-rolled steel coil after the coiling of the steel.

[0020] The transport cart device bearing a thermal insulation enclosure can satisfy the requirement of on-line heat treatment of a steel coil. The transport cart device can move on the transport chain roller bed and transport the steel coil that has been hot rolled and coiled to the thermal insulation zone of the transport chain to accomplish heat treatment. The thermal insulation enclosure and the transport cart device can be separated and combined by using a thermal insulation enclosure up-transfer hoisting device and a thermal insulation enclosure down-transfer hoisting device.

[0021] Single thermal insulation enclosure zone: a steel coil is subjected to thermal insulation heat treatment in a transport cart device bearing a thermal insulation enclosure. The purpose of heat treatment is achieved by controlling the running time of the transport cart device bearing a thermal insulation enclosure on the heat treatment transport chain roller bed.

[0022] The layout of the single thermal insulation enclosure zone needs to be coordinated with the transport cart devices bearing thermal insulation enclosures, with the number of hot-rolled steel coils to be insulated and the time of insulation being taken into account. Assuming that the number of thermal insulation enclosures for hot steel coils is n, the number of steel coil transport carts on the production line should be > n + 1. After a thermal insulation enclosure is separated from a transport cart device at the thermal insulation enclosure down-transfer hoisting device, the thermal insulation enclosure, together with the transport cart, returns to the up-transfer hoisting device along the back-haul transport chain roller bed.

[0023] According to the present invention, special batches of hot-rolled strip steel can be subjected to special treatment such as in-depth processing when necessary, and heat treatment work stations can be added in

the thermal insulation zone. The heat treatment work station is provided with a heating system for heating the interior of the thermal insulation enclosure and a protective cooling gas input system.

[0024] For hot-rolled strip steel that needs to be heated, a hot-rolled strip steel transport cart transports the hot-rolled steel coil to a work station where the heating system for heating the interior will heat the hot-rolled strip steel. Relevant heat treatment curves and process requirements may be utilized to perform the secondary heating of the steel coil to improve the overall performances of the hot-rolled strip steel.

[0025] In the case that hot-rolled strip steel needs gas protection and rapid controlled cooling, the transport cart device carrying a thermal insulation enclosure that has entered the processing work station is coupled to the protective cooling gas input system. The requirement for controlling the internal temperature of the thermal insulation enclosure device may be fulfilled by controlling the volume and proportion of the protective gas that is input. Relevant heat treatment curves and process requirements may be utilized to perform the secondary heating of the steel coil to improve the overall performances of the hot-rolled strip steel.

[0026] After the thermal insulation enclosure is separated from the hot-rolled steel strip, the hot-rolled strip steel transport cart transports the hot-rolled strip steel to an information code printing station where the coil information will be printed on the steel coil. After it's confirmed that the steel coil separated from the thermal insulation enclosure carries the steel coil information, the steel coil is conveyed to the next production line for further processing.

[0027] After the information printing step is completed, the heat-treated steel coil is transported along the transport chain roller bed to a steel coil warehouse, or transported via the transport chain system to the next working procedure of the production line to continue the production.

[0028] According to the present invention, the processing line is also provided with a heat treatment work station and an information code printing device. A special batch of hot-rolled strip steel may need to be subjected to special treatment such as in-depth processing in the heat treatment work station. A heat treatment work station may be added in the thermal insulation zone. The heat treatment work station is provided with a heating system for heating the interior of the thermal insulation enclosure and a protective cooling gas input system.

[0029] Information code printing device: a hot-rolled strip steel transport cart transports the hot-rolled strip steel to an information code printing station where the coil information will be printed on the steel coil.

[0030] Heat-treated steel coils may be transported along the transport chain roller bed to a steel coil warehouse. If a steel coil needs cold rolling, flattening or trimming, a transport cart rotating roller bed device is used to transfer the steel coil to a transport chain roller bed in the next working procedure.

[0031] It is a pioneering technology to complete thermal insulation, soaking and slow cooling of a steel coil using steel coil transport equipment on line. The thermal insulation enclosure exists individually and independently, and the temperature of each steel coil can be controlled during transportation on the transport chain. This saves time, and also improves production rhythm and efficiency.

[0032] The beneficial effects of the present invention include:

According to the present invention, the hot-rolling on-line movable thermal insulation heat treatment process realizes on-line movable heat treatment of a hot coil by using a thermal insulation device directly after coiling of the hot coil. When this process is used in place of the traditional off-line heat treatment, the purpose of improving product performances and plate shape quality, saving energy and reducing consumption can be achieved.

[0033] Thermal insulation heat treatment of hot-rolled and cold-rolled high-strength steel hot coils in an "on-line mode" avoids the influence of air cooling after coiling on the performances of the steel coils, and improves the performances of the hot-rolled and cold-rolled high-strength steel.

[0034] The present invention realizes on-line heat treatment during the transport chain transportation for a hot-rolled steel coil after coiling. After the steel coil leaves a coiler where the coiling is done, a movable hot coil thermal insulation heat treatment device is applied to the steel coil immediately. The heat of the steel coil itself is exploited to implement the heat treatment process including soaking and slow cooling of the steel coil to achieve the goals of high efficiency, energy saving and high yield rate.

[0035] On the production line according to the present invention, after coiling, the strip steel coil is subjected to thermal insulation treatment at the earliest time. This greatly addresses the challenges of insufficient performance improvement caused by the excessively long time from coiling to entry of the steel coil to the slow cooling device, and large performance fluctuation of the strip steel in the length and width directions. In addition, severe fluctuation of rolling force in cold rolling production, and failure to meet the tolerance standard for the thickness of final cold-rolled products are avoided. The rolling stability of cold-rolling - pickling - continuous rolling mills is improved, and the yield rate of cold-rolled ultra-high-strength steel is increased.

1. Real time: thermal insulation treatment of a hot coil is implemented directly after coiling, and the interval is short.
2. On line: thermal insulation of a hot coil is implemented directly on a transport chain with no redundant process.
3. Economy: residual heat of a steel coil is exploited to implement the post-coiling heat treatment, which

is energy saving and environmentally friendly.

4. Process: the thermal insulation effect is ideal, and the requirements of high-strength steel on thermal insulation process can be satisfied.

Description of the Drawings

[0036]

Figs. 1 and 2 are schematic graphs showing the influence of on-line movable insulation on steel coil performances.

Fig. 3 is a schematic view of an embodiment of a hot-rolled strip steel heat treatment line according to the present invention.

Fig. 4 is a schematic view of an embodiment of a hot-rolled strip steel heat treatment line according to the present invention.

Fig. 5 is a schematic view of an embodiment of a hot-rolled strip steel heat treatment line according to the present invention.

Fig. 6 is a schematic view showing the structure of a movable hot coil thermal insulation heat treatment device in Example 1 according to the present invention.

Fig. 7 is a side view of the movable hot coil thermal insulation heat treatment device in Example 1 according to the present invention.

Fig. 8 is a front view of the movable hot coil thermal insulation heat treatment device in Example 2 according to the present invention.

Fig. 9 is a front view of the movable hot coil thermal insulation heat treatment device in Example 3 according to the present invention.

Fig. 10 is a partial cutaway view of the thermal insulation enclosure in the movable hot coil thermal insulation heat treatment device in the Examples according to the present invention.

Fig. 11 is a stereogram of the movable hot coil thermal insulation heat treatment device in Example 1 according to the present invention.

Fig. 12 is a front view of the movable hot coil thermal insulation heat treatment device in Example 1 according to the present invention.

Fig. 13 is a stereogram of the bottom sealing device in the movable hot coil thermal insulation heat treatment device in Example 1 according to the present invention.

Fig. 14 is a front view of the movable hot coil thermal insulation heat treatment device in Example 1 according to the present invention.

Fig. 15 is a side view of the device shown in Fig. 14.

Fig. 16 is an upward stereogram of the movable hot coil thermal insulation heat treatment device in Example 1 according to the present invention.

Fig. 17 is an enlarged schematic view of part A in Fig. 16.

Detailed Embodiments

[0037] A hot-rolling on-line movable thermal insulation heat treatment process is provided according to the present invention, wherein a slab is heated, rolled, laminar-flow cooled, and coiled to a hot coil state; after the hot coil is unloaded and bundled, a movable hot coil thermal insulation heat treatment device is applied to the hot coil within 30 minutes to start heat treatment on the hot coil while the hot coil is simultaneously transported online to a hot coil thermal insulation treatment zone; after heat treatment for a period of time of 1 to 48 hours, the steel coil is cooled in air and then sent to a warehouse, wherein a coiling temperature is controlled between 250 °C and 750 °C.

[0038] Preferably, the movable hot coil thermal insulation heat treatment device is applied to the hot coil within 10 minutes after the coiling is completed.

[0039] Preferably, the movable hot coil thermal insulation heat treatment device is a transport cart with a thermal insulation enclosure.

[0040] Preferably, a natural cooling rate in the movable hot coil thermal insulation heat treatment device is from 1 to 10°C/h.

[0041] Preferably, a heating system and/or a vacuuming system and/or an inert gas filling system are provided in the movable hot coil thermal insulation heat treatment device.

[0042] Referring to Figs. 1 and 2, according to the present invention, the thermal insulation heat treatment of hot-rolled and cold-rolled high-strength steel hot coils in an "on-line mode" avoids the influence of air cooling after coiling on the performances of the steel coils, and improves the performances of the hot-rolled and cold-rolled high-strength steel.

[0043] Referring to Fig. 3, according to the present invention, there is provided a hot-rolled strip steel heat treatment line, wherein a heat treatment transport chain roller bed 30 is provided between a bundling device 20 downstream of a hot-rolled steel coiler 10 and a cold rolling set; at least one movable hot coil thermal insulation heat treatment device 40 is provided on the heat treatment transport chain roller bed 30; correspondingly, hoisting devices 50, 50' capable of loading and unloading a steel coil to the movable hot coil thermal insulation heat treatment device are positioned respectively at two ends of the heat treatment transport chain roller bed 30; and a thermal insulation enclosure for closed on-line thermal insulation of the hot-rolled steel coil is provided on the movable hot coil thermal insulation heat treatment device 40.

[0044] Referring to Fig. 4, at least one heat treatment work station 80 is provided on the heat treatment transport chain roller bed 30 or the thermal insulation transport chain roller bed 70; a heating system for heating an interior of the thermal insulation enclosure in the movable hot coil thermal insulation heat treatment device and/or a protective cooling gas input system for gas cooling are

provided in the heat treatment work station 80 represents a rotating roller bed.

[0045] Referring to Fig. 5, a steel coil thermal insulation zone 60 is provided on one side of the heat treatment transport chain roller bed 30, wherein at least one thermal insulation transport chain roller bed 70 coupled to the heat treatment transport chain roller bed 30 and a hoisting device 50' are provided in the steel coil thermal insulation zone 60.

[0046] Referring to Fig. 5, an information code printing device 90 for printing steel coil information on the steel coil is provided at one end of the heat treatment transport chain roller bed 30 facing the cold rolling set.

[0047] Referring to Figs. 5-17, the movable hot coil thermal insulation heat treatment device 40 according to the present invention comprises:

a baseboard 1;
a steel coil fixture 2 provided at a central portion of an upper end surface of the baseboard 1;
a tray 3 having an annular structure, wherein the tray 3 is horizontally arranged by nesting at a middle part of the steel coil fixture 2;
a thermal insulation enclosure 4, which has an open lower end and an inner chamber having a volume larger than a steel coil 100, wherein the thermal insulation enclosure 4 is arranged on the tray 3;
an electric heating device 5 provided on an inner side wall of the thermal insulation enclosure 4;
a temperature sensor 6 provided in the thermal insulation enclosure 4; and
an information acquisition control module 7, wherein the electric heating device 5 and the temperature sensor 6 are electrically coupled to the information acquisition control module 7.

[0048] Further, it further comprises a gas protection device and gas sensors 8, 8' which are electrically coupled to the information acquisition control module 7, respectively.

[0049] Preferably, a signal emitting module is provided in the information acquisition control module 7.

[0050] The steel coil fixture 2 comprises two juxtaposed support bodies 21, 22, wherein upper end faces of the two support bodies 21, 22 are inclined surfaces and are arranged symmetrically; and side sealing devices 9, 9' are arranged at a gap between the two support bodies 21, 22 at two sides of the two support bodies 21, 22.

[0051] Still further, a bottom sealing device 11 is arranged between bottoms of the two support bodies 21, 22 of the steel coil fixture 2 to close the gap between the bottoms of the two support bodies 21, 22.

[0052] The bottom sealing device 11 comprises:

a support plate 111 provided between the two support bodies 21, 22 of the steel coil fixture 2, wherein the support plate 111 is arranged vertically, and a plurality of rollers 112 are provided on lower parts of two sides of the support plate 111 at even spacings in a length direction to form a slidable mechanism; and
a sealing plate 113 provided horizontally on a top surface of the support plate 111, wherein the sealing plate has a size corresponding to the gap between the bottoms of the two support bodies 21, 22.

[0053] Preferably, the sealing plate 113 has a composite layered structure, wherein an intermediate part of the structure is consisting of an insulating felt, and two side parts are high temperature resistant steel plates.

[0054] Preferably, an electromagnetic block 114 is provided on an end face of the support plate 111, and correspondingly, a metal stopper matching the electromagnetic block 114 is provided between end portions of the two support bodies 21, 22 of the steel coil fixture 2 at one side.

[0055] Referring to Figs. 15-17, the side sealing device 9 (which is taken as an example; the same below) comprises:

two fixed baseboards 91, 91' respectively provided horizontally at a bottom of the gap at an outer side of the two support bodies 21, 22 of the steel coil fixture 2, wherein a plurality of guide rollers 92, 92' spaced in an axial direction are provided on an outer side surface of the fixed baseboards 91, 91';
two sealing members 93, 93' respectively arranged at the gap at two sides of the two support bodies 21, 22 of the steel coil fixture 2, wherein bottom ends of the sealing members 93, 93' are provided slidably on the guide rollers 92, 92' of the fixed baseboard 91;
a driving mechanism 94, comprising:

two racks 941 respectively provided horizontally on the two sealing members 93, 93' with one end of the rack 941 being coupled to the sealing members 93, 93';
a drive shaft 942, arranged horizontally at a side of the support body 21 opposite to the gap through two bearing pedestals 943, wherein a gear 944 is provided at each of two ends of the drive shaft 942, wherein the gear 943 meshes with the rack 941.

[0056] Preferably, the bearing pedestal 943 is provided on one side of the support body 21 by using a fixing plate 945, wherein one side of the fixing plate 945 is provided with a through hole 9451 for the rack 941 to pass through, and a roller 946 abutted against a top surface of the rack 941 is provided at an outer side of the fixing plate 945 above the through hole 9451.

[0057] Preferably, the sealing member 93 has a composite layered structure, wherein an intermediate part of the structure is an insulating material, and two sides of the intermediate part are cladded with a high temperature

resistant steel plate.

[0058] Preferably, the sealing member 93 is a right angle plate structure.

[0059] Preferably, a positioning sleeve 12 is provided on a lower part of a side of the thermal insulation enclosure 4. Correspondingly, a positioning pin 13 matching the positioning sleeve 12 is provided on the tray 3 for the thermal insulation enclosure. The positioning pin 13 is preferably a cone-shaped body.

[0060] Preferably, the thermal insulation enclosure 4 is provided with a ventilation hole and a corresponding exhaust valve 41.

[0061] Preferably, the thermal insulation enclosure 4 has a composite structure, comprising: an outer protection layer, which is a high-strength steel plate; an intermediate layer, which is a thermal insulation material; and an inner layer, which is a high temperature resistant stainless steel plate.

[0062] Preferably, the thermal insulation enclosure 4 is a composite structure, comprising an inner radiation layer 42, an electric heating wire layer 43, an intermediate mesh cover 44, an intermediate thermal insulation layer 45, and an outer protection layer 46 in order from inside to outside. The composite structure of the thermal insulation enclosure is fixed with an anchor nail 47.

[0063] Referring to Figs. 5 and 6, the thermal insulation enclosure 4 is a square thermal insulation enclosure or a circular thermal insulation enclosure.

[0064] Preferably, the electric heating device 5 is an electric heating wire, and the temperature sensor 6 is a thermocouple sensor.

[0065] The thermal insulation treatment of a strip steel coil after coiling according to the present invention also fulfils the purpose of annealing treatment by making use of the residual heat in the steel coil that has just been coiled, which greatly addresses the challenges of insufficient performance improvement caused by the excessively long time from coiling to entry of the steel coil to the slow cooling device, and large performance fluctuation of the strip steel in the length and width directions.

[0066] A special batch of hot-rolled strip steel may need to be subjected to special treatment such as in-depth processing. The heating device and protective cooling gas input system provided in the thermal insulation enclosure can cooperate to achieve temperature control under necessary conditions.

Claims

1. A hot-rolling on-line movable thermal insulation heat treatment process, wherein a slab is heated, rolled, laminar-flow cooled, and coiled to a hot coil state; after the hot coil is unloaded and bundled, a movable hot coil thermal insulation heat treatment device (40) is applied to the hot coil within 30 minutes to start heat treatment on the hot coil while the hot coil is simultaneously transported on-line to a hot coil thermal insulation treatment zone; after heat treatment for a period of time of 1 to 48 hours, the steel coil is cooled in air and then sent to a warehouse, wherein a coiling temperature is controlled between 250 °C and 750 °C, wherein the movable hot coil thermal insulation heat treatment device (40) further comprises:

   a baseboard (1),
   a steel coil fixture (2) provided at a central portion of an upper end surface of the baseboard (1) and comprising two juxtaposed support bodies (21, 22), wherein upper end faces of the two support bodies (21, 22) are inclined surfaces and are arranged symmetrically, wherein a side sealing device (9, 9') is arranged at a gap at each of two sides of the two support bodies (21, 22), and wherein a bottom sealing device (11) is arranged between bottoms of the two support bodies (21, 22) of the steel coil fixture (2) to close the gap between the bottoms of the two support bodies (21, 22),

   the bottom sealing device comprising (11):

      a support plate (111) provided between the two support bodies (21, 22) of the steel coil fixture (2), wherein the support plate (111) is arranged vertically, and a plurality of rollers (112) are provided on lower parts of two sides of the support plate (111) at even spacings in a length direction to form a slidable mechanism, and
      a sealing plate (113) provided horizontally on a top surface of the support plate (111), wherein the sealing plate (113) has a size corresponding to the gap between the bottoms of the two support bodies (21, 22),

   the side sealing device (9) comprising:

      two fixed baseboards (91, 91') each provided horizontally at a bottom of the gap at an outer side of the two support bodies (21, 22) of the steel coil fixture (2), wherein a plurality of guide rollers (92, 92') spaced in an axial direction are provided on an outer side surface of each of the fixed baseboards (91, 91'), two sealing members (93, 92'), each arranged at the gap at one of the two sides of the two support bodies (21, 22) of the steel coil fixture (2), wherein a bottom end of the sealing member (93, 93' is provided slidably on the guide rollers (92, 92') of the fixed baseboard (91,

91'), and
a driving mechanism (94) further comprising two racks (941), each provided horizontally on one of the two sealing members (93, 93') with one end of the rack (941) being coupled to the seal member (93, 93'), and a drive shaft (942), arranged horizontally at a side of the support body (21, 22)) opposite to the gap through two bearing pedestals (943), two gears (944), each provided at one of two ends of the drive shaft (942), wherein the gear (944) meshes with the rack (941),

a tray (3) which is an annular structure and horizontally arranged by nesting at a middle part of the steel coil fixture (2),
a thermal insulation enclosure (4), which has an open lower end and an inner chamber having a volume larger than a steel coil (100), wherein the thermal insulation enclosure (4) is arranged on the tray (3),
an electric heating device (5) provided on an inner side wall of the thermal insulation enclosure (4),
a temperature sensor (6) provided in the thermal insulation enclosure (4), and an information acquisition control module (7), wherein the electric heating device (5) and the temperature sensor (6) are electrically coupled to the information acquisition control module (7).

2. The hot-rolling on-line movable thermal insulation heat treatment process according to claim 1, wherein the movable hot coil thermal insulation heat treatment device (40) is applied to the hot coil within 10 minutes after the coiling is completed.

3. The hot-rolling on-line movable thermal insulation heat treatment process according to claim 1 or 2, wherein the movable hot coil thermal insulation heat treatment device (40) is a transport cart with a thermal insulation enclosure (4).

4. The hot-rolling on-line movable thermal insulation heat treatment process according to any one of claims 1 to 3, wherein a natural cooling rate within the movable hot coil thermal insulation heat treatment device (40) is from 1 to 10 °C/h.

5. The hot-rolling on-line movable thermal insulation heat treatment process according to any one of claim 1 to 4, wherein a heating system and/or a vacuuming system and/or an inert gas filling system are provided in the movable hot coil thermal insulation heat treatment device (40).

6. A hot-rolling on-line movable thermal insulation heat treatment line, comprising:

a heat treatment transport chain roller bed (30) provided between a bundling device (20) downstream of a hot-rolled steel coiler (10) and a cold rolling set;
at least one movable hot coil thermal insulation heat treatment device (40) positioned on the heat treatment transport chain roller bed (30), the at least one movable hot coil thermal insulation heat treatment device (40) further comprising:

a baseboard (1),
a steel coil fixture (2) provided at a central portion of an upper end surface of the baseboard (1) and comprising two juxtaposed support bodies (21, 22), wherein upper end faces of the two support bodies (21, 22) are inclined surfaces and are arranged symmetrically, wherein a side sealing device (9, 9') is arranged at a gap at each of two sides of the two support bodies (21, 22), and wherein a bottom sealing device (11) is arranged between bottoms of the two support bodies (21, 22) of the steel coil fixture (2) to close the gap between the bottoms of the two support bodies (21, 22),

the bottom sealing device (11) comprising:

a support plate (111) provided between the two support bodies (21, 22) of the steel coil fixture (2), wherein the support plate (111) is arranged vertically, and a plurality of rollers (112) are provided on lower parts of two sides of the support plate (111) at even spacings in a length direction to form a slidable mechanism, and
a sealing plate (113) provided horizontally on a top surface of the support plate (111), wherein the sealing plate (113) has a size corresponding to the gap between the bottoms of the two support bodies (21, 22),

the side sealing device (9) comprising:

two fixed baseboards (91, 91') each provided horizontally at a bottom of the gap at an outer side of the two support bodies (21, 22) of the steel coil fixture (2), wherein a

plurality of guide rollers (92, 92') spaced in an axial direction are provided on an outer side surface of each of the fixed baseboards (91, 91'),
two sealing members (93, 92'), each arranged at the gap at one of the two sides of the two support bodies (21, 22) of the steel coil fixture (2), wherein a bottom end of the sealing member (93, 93') is provided slidably on the guide rollers (92, 92') of the fixed baseboard (91, 91'), and
a driving mechanism (94) further comprising two racks (941), each provided horizontally on one of the two sealing members (93, 93') with one end of the rack (941) being coupled to the seal member (93, 93'), and a drive shaft (942), arranged horizontally at a side of the support body (21, 22)) opposite to the gap through two bearing pedestals (943), two gears (944), each provided at one of two ends of the drive shaft (942), wherein the gear (944) meshes with the rack (941),

a tray (3) which is an annular structure and horizontally arranged by nesting at a middle part of the steel coil fixture (2),
a thermal insulation enclosure (4), which has an open lower end and an inner chamber having a volume larger than a steel coil (100), wherein the thermal insulation enclosure (4) is arranged on the tray (3),
an electric heating device provided on an inner side wall of the thermal insulation enclosure,
a temperature sensor provided in the thermal insulation enclosure, and an information acquisition control module, wherein the electric heating device and the temperature sensor are electrically coupled to the information acquisition control module;

correspondingly, a hoisting device (50, 50') capable of loading and unloading the steel coil (100) to the movable hot coil thermal insulation heat treatment device (40) positioned at each end of the heat treatment transport chain roller bed (30).

7. The hot-rolling on-line movable thermal insulation heat treatment line according to claim 6, wherein a steel coil thermal insulation zone (60) is provided at one side of the heat treatment transport chain roller bed (30), and at least one thermal insulation transport chain roller bed (70) coupled to the heat treatment transport chain roller bed (30) is provided in the steel coil thermal insulation zone (60).

8. The hot-rolling on-line movable thermal insulation heat treatment line according to claim 6 or 7, wherein at least one heat treatment work station (80) is provided on the heat treatment transport chain roller bed (30) or the thermal insulation transport chain roller bed (70), and a heating system for heating an interior of the thermal insulation enclosure (4) in the movable hot coil thermal insulation heat treatment device (40) and/or a protective cooling gas input system for gas cooling are provided in the heat treatment work station (80).

9. The hot-rolling on-line movable thermal insulation heat treatment line according to any one of claims 6 to 8, wherein an information code printing device (90) for printing steel coil information on the steel coil (100) is provided at one end of the heat treatment transport chain roller bed (30) facing the cold rolling set.

10. The hot-rolling on-line movable thermal insulation heat treatment line according to any one of claims 6 to 9, wherein the movable hot coil thermal insulation heat treatment device (40) further comprises a gas protection device and a gas sensor (8, 8') which are electrically coupled to the information acquisition control module (7), respectively.

11. The hot-rolling on-line movable thermal insulation heat treatment line according to any one of claims 6 to 10, wherein a signal emitting module is provided in the information acquisition control module (7).

12. The hot-rolling on-line movable thermal insulation heat treatment line according to any one of claims 6 to 11, wherein an electromagnetic block (114) is provided on an end face of the support plate (111), and correspondingly, a metal stopper matching the electromagnetic block (114) is provided between end portions of the two support bodies (21, 22) of the steel coil fixture (2) at one side.

13. The hot-rolling on-line movable thermal insulation heat treatment line according to any one of claims 6 to 12, wherein the bearing pedestal (943) is provided on one side of the support body (21, 22) by using a fixing plate (945), wherein one side of the fixing plate (945) is provided with a through hole (9451) for the rack (941) to pass through, and a roller (946) abutted against a top surface of the rack (941) is provided at an outer side of the fixing plate (945) above the through hole (9451).

14. The hot-rolling on-line movable thermal insulation heat treatment line according to any one of claims 6 to 13, wherein the sealing plate (113) and the sealing member (93, 93') have a composite layered structure, wherein an intermediate part of the structure is an insulating felt, and two sides of the intermediate part are cladded with a high temperature resistant steel plate.

15. The hot-rolling on-line movable thermal insulation heat treatment line according to any one of claims 6 to 14, wherein a positioning sleeve (12) is provided on a lower part of a side of the thermal insulation enclosure (4); correspondingly, a positioning pin (13) matching the positioning sleeve (12) is provided on the tray (3) for the thermal insulation enclosure (4); the positioning pin (13) is preferably a cone-shaped body.

16. The hot-rolling on-line movable thermal insulation heat treatment line according to any one of claims 6 to 15, wherein the thermal insulation enclosure (4) is provided with a ventilation hole and a corresponding exhaust valve (41).

17. The hot-rolling on-line movable thermal insulation heat treatment line according to any one of claims 6 to 16, wherein the thermal insulation enclosure (4) has a composite structure, comprising: an outer protection layer, which is a high-strength steel plate; an intermediate layer, which is a thermal insulation material; and an inner layer, which is a high temperature resistant stainless steel plate.

18. The hot-rolling on-line movable thermal insulation heat treatment line according to any one of claims 6 to 17, wherein the thermal insulation enclosure (4) is a composite structure, comprising an inner radiation layer (42), an electric heating wire layer (43), an intermediate mesh cover (44), an intermediate thermal insulation layer (45), and an outer protection layer (46) in order from inside to outside.

19. The hot-rolling on-line movable thermal insulation heat treatment line according to any one of claims 6 to 18, wherein the electric heating device (5) is an electric heating wire, and the temperature sensor (6) is a thermocouple sensor.

Patentansprüche

1. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang, wobei eine Bramme erwärmt, gewalzt, laminarströmungsgekühlt und zu einem Warmwickelzustand gewickelt wird; nachdem die warme Rolle ausgeladen und gebündelt wurde, wirkt eine bewegliche Wärmeisolationswärmebehandlungswarmwalzvorrichtung (40) 30 Minuten lang auf die warme Rolle, um die Wärmebehandlung der warmen Rolle zu beginnen, während die warme Rolle gleichzeitig auf der Linie zu einer Warmrollenwärmeisolationsbehandlungszone transportiert wird; nach einer Wärmebehandlung für die Dauer von 1 bis 48 Stunden wird die Stahlrolle an der Luft gekühlt und dann in ein Lager geschickt, wobei eine Wickeltemperatur zwischen 250 °C und 750 °C eingestellt wird, wobei die bewegliche Wärmeisolationswärmebehandlungswarmwalzvorrichtung (40) ferner aufweist:

eine Sockelleiste (1)
eine Stahlrollenhalterung (2), die sich an einem zentralen Abschnitt einer oberen Endoberfläche der Sockelleiste (1) befindet und zwei aneinandergereihte Haltekörper (21, 22) aufweist, wobei obere Endflächen der zwei Haltekörper (21, 22) geneigte Oberflächen sind und symmetrisch angeordnet sind, wobei eine Seitenabdichtungsvorrichtung (9, 9') an einer Lücke bei jeder der zwei Seiten der zwei Haltekörper (21, 22) angeordnet ist, und wobei eine Bodenabdichtungsvorrichtung (11) zwischen Böden der zwei Haltekörper (21, 22) der Stahlrollenhalterung (2) angeordnet ist, um die Lücke zwischen den Böden der zwei Haltekörper (21, 22) zu schließen, wobei die Bodenabdichtungsvorrichtung (11) aufweist:

eine Halteplatte (111), die sich zwischen den zwei Haltekörpern (21, 22) der Stahlrollenhalterung (2) befindet, wobei die Halteplatte (111) vertikal angeordnet ist, und sich eine Mehrzahl an Walzen (112) an unteren Teilen der zwei Seiten der Halteplatte (111) in gleichmäßigen Abständen in einer Längsrichtung befinden, um einen gleitbaren Mechanismus zu bilden, und
eine Abdichtungsplatte (113), die sich horizontal auf einer oberen Oberfläche der Halteplatte (111) befindet, wobei die Abdichtungsplatte (113) eine Größe aufweist, die der Lücke zwischen den Böden der zwei Haltekörper (21, 22) entspricht, wobei die Seitenabdichtungsvorrichtung (9) aufweist:

zwei befestigte Sockelleisten (91, 91'), die sich jeweils horizontal an einem Boden der Lücke an einer Außenseite der zwei Haltekörper (21, 22) der Stahlrollenhalterung (2) befinden, wobei sich eine Mehrzahl an Führungswalzen (92, 92'), die in einer axialen Richtung beabstandet sind, an einer Außenseitenoberfläche von jeder der befestigten Sockelleisten (91, 91') befinden, zwei

Abdichtungselemente (93, 92'), die jeweils an der Lücke an einer der zwei Seiten der zwei Haltekörper (21, 22) der Stahlrollenhalterung (2) angeordnet sind, wobei sich ein Bodenende des Abdichtungselements (93, 93') gleitbar an den Führungswalzen (92, 92') der befestigten Sockelleiste (91, 91') befindet, und

ein Antriebsmechanismus (94), der ferner zwei Stangen (941), wobei sich jede horizontal an einem der beiden Abdichtungselemente (93, 93') befindet, wobei ein Ende der Stange (941) mit dem Abdichtungselement (93, 93') verbunden ist, und eine Antriebswelle (942), die horizontal an einer Seite des Haltekörpers (21, 22) gegenüber der Lücke durch zwei Lagerträger (943) angeordnet ist, zwei Zahnräder (944), die sich jeweils an einem der zwei Enden der Antriebswelle (942) befinden, wobei das Zahnrad (944) mit der Stange (941) ineinandergreift, aufweist,

ein Fach (3), das eine kreisrunde Struktur ist und durch eine Schachtelung an einem mittleren Teil der Stahlrollenhalterung (2) horizontal angeordnet ist,

ein Wärmeisolationsgehäuse (4), das ein offenes unteres Ende und eine innere Kammer mit einem Volumen aufweist, das größer ist als eine Stahlrolle (100), wobei das Wärmeisolationsgehäuse (4) an dem Fach (3) angeordnet ist,

eine elektrische Heizvorrichtung (5), die sich an einer inneren Seitenwand des Wärmeisolationsgehäuses (4) befindet,

einen Temperatursensor (6), der sich in dem Wärmeisolationsgehäuse (4) befindet, und

ein Informationsermittlungssteuermodul (7), wobei die elektrische Heizvorrichtung (5) und der Temperatursensor (6) mit dem Informationsermittlungssteuermodul (7) elektrisch verbunden sind.

2. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach Anspruch 1, wobei die bewegliche Wärmeisolationswärmebehandlungswarmwalzvorrichtung (40) innerhalb von 10 Minuten, nachdem das Wickeln beendet wurde, auf die warme Rolle angewendet wird.

3. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach Anspruch 1 oder 2, wobei die bewegliche Wärmeisolationswärmebehandlungswarmwalzvorrichtung (40) ein Transportkarren mit einem Wärmeisolationsgehäuse (4) ist.

4. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach einem der Ansprüche 1 bis 3, wobei eine natürliche Kühlrate innerhalb der beweglichen Wärmeisolationswärmebehandlungswarmwalzvorrichtung (40) von 1 bis 10 °C/h beträgt.

5. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach einem der Ansprüche 1 bis 4, wobei ein Heizsystem und/oder ein Vakuumsystem und/oder ein Edelgasfüllsystem in der beweglichen Wärmeisolationswärmebehandlungswarmwalzvorrichtung (40) vorhanden sind.

6. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang, aufweisend:

ein Wärmebehandlungstransportkettenwalzbett (30), das sich zwischen einer Bündelungsvorrichtung (20) stromabwärts von einem Warmwalzstahlwickler (10) und einem Kaltwalzset befindet;

zumindest eine bewegliche Wärmeisolationswärmebehandlungswarmwalzvorrichtung (40), die an dem Wärmebehandlungstransportkettenwalzbett (30) positioniert ist, wobei die zumindest eine bewegliche Wärmeisolationswärmebehandlungswarmwalzvorrichtung (40) ferner aufweist:

eine Sockelleiste (1),

eine Stahlrollenhalterung (2), die sich an einem zentralen Abschnitt einer oberen Endoberfläche der Sockelleiste (1) befindet und zwei aneinandergereihte Haltekörper (21, 22) aufweist, wobei obere Endflächen der zwei Haltekörper (21, 22) geneigte Oberflächen sind und symmetrisch angeordnet sind, wobei eine Seitenabdichtungsvorrichtung (9, 9') an einer Lücke bei jeder der zwei Seiten der zwei Haltekörper (21, 22) angeordnet ist, und wobei eine Bodenabdichtungsvorrichtung (11) zwischen Böden der zwei Haltekörper (21, 22) der Stahlrollenhalterung (2) angeordnet ist, um die Lücke zwischen den Böden der zwei Haltekörper (21, 22) zu schließen,

wobei die Bodenabdichtungsvorrichtung (11) aufweist:

eine Halteplatte (111), die sich zwischen den zwei Haltekörpern (21, 22) der Stahlrollenhalterung (2) befindet,

wobei die Halteplatte (111) vertikal angeordnet ist, und sich eine Mehrzahl an Walzen (112) an unteren Teilen der zwei Seiten der Halteplatte (111) in gleichmäßigen Abständen in einer Längenrichtung befinden, um einen gleitbaren Mechanismus zu bilden, und
eine Abdichtungsplatte (113), die sich horizontal auf einer oberen Oberfläche der Halteplatte (111) befindet, wobei die Abdichtungsplatte (113) eine Größe aufweist, die der Lücke zwischen den Böden der zwei Haltekörper (21, 22) entspricht, wobei die Seitenabdichtungsvorrichtung (9) aufweist:

zwei befestigte Sockelleisten (91, 91'), die sich jeweils horizontal an einem Boden der Lücke an einer Außenseite der zwei Haltekörper (21, 22) der Stahlrollenhalterung (2) befinden, wobei sich eine Mehrzahl an Führungswalzen (92, 92'), die in einer axialen Richtung beabstandet sind, an einer Außenseitenoberfläche von jeder der befestigten Sockelleisten (91, 91') befinden, zwei Abdichtungselemente (93, 92'), die jeweils an der Lücke an einer der zwei Seiten der zwei Haltekörper (21, 22) der Stahlrollenhalterung (2) angeordnet sind, wobei sich ein Bodenende des Abdichtungselements (93, 93') gleitbar an den Führungswalzen (92, 92') der befestigten Sockelleiste (91, 91') befindet, und
ein Antriebsmechanismus (94), der ferner zwei Stangen (941), wobei sich jede horizontal an einem der beiden Abdichtungselemente (93, 93') befindet, wobei ein Ende der Stange (941) mit dem Abdichtungselement (93, 93') verbunden ist, und eine Antriebswelle (942), die horizontal an einer Seite des Haltekörpers (21, 22) gegenüber der Lücke durch zwei Lagerträger (943) angeordnet ist, zwei Zahnräder (944), die sich jeweils an einem der zwei Enden der Antriebswelle (942) befinden, wobei das Zahnrad (944) mit der Stange (941) ineinandergreift, aufweist,
ein Fach (3), das eine kreisrunde Struktur ist und durch eine Schachtelung an einem mittleren Teil der Stahlrollenhalterung (2) horizontal angeordnet ist,
ein Wärmeisolationsgehäuse (4), das ein offenes unteres Ende und eine innere Kammer mit einem Volumen aufweist, das größer ist als eine Stahlrolle (100), wobei das Wärmeisolationsgehäuse (4) an dem Fach (3) angeordnet ist,
eine elektrische Heizvorrichtung, die sich an einer inneren Seitenwand des Wärmeisolationsgehäuses befindet,
einen Temperatursensor, der sich in dem Wärmeisolationsgehäuse befindet, und ein Informationsermittlungssteuermodul, wobei die elektrische Heizvorrichtung und der Temperatursensor mit dem Informationsermittlungssteuermodul elektrisch verbunden sind;
wobei entsprechend eine Hubvorrichtung (50, 50'), die in der Lage ist, die Stahlrolle (100) in die bewegliche Wärmeisolationswärmebehandlungswarmwalzvorrichtung (40) zu laden und aus dieser abzuladen, an jedem Ende des Wärmebehandlungstransportkettenwalzbetts (30) positioniert ist.

7. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach Anspruch 6, wobei sich eine thermische Stahlrollenisolationszone (60) an einer Seite des Wärmebehandlungstransportkettenwalzbetts (30) befindet, und sich zumindest ein Wärmeisolationstransportkettenwalzbett (70), das mit dem Wärmebehandlungstransportkettenwalzbett (30) verbunden ist, in der thermischen Stahlrollenisolationszone (60) befindet.

8. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach Anspruch 6 oder 7, wobei sich zumindest eine Wärmebehandlungsarbeitsstation (80) an dem Wärmebehandlungstransportkettenwalzbett (30) oder dem Wärmeisolationstransportkettenwalzbett (70) befindet, und sich ein Heizsystem zum Heizen eines Inneren des Wärmeisolationsgehäuses (4) in der beweglichen Warmwalzwärmeisolationswärmebehandlungsvorrichtung (40) und/oder ein Schutzkühlgaseinlasssystem zur Gaskühlung in der Wärmebehandlungsarbeitsstation (80) befinden.

9. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach einem der Ansprüche 6 bis 8, wobei sich eine Informationscodedruckvorrichtung (90) zum Drucken von Stahlrolleninformationen auf die Stahlrolle (100) an einem En-

de des Wärmebehandlungstransportkettenwalzbett (30) gegenüber des Kaltwalzsets befindet.

10. Bewegliche Wärmeisolationswärmebehandlungswarmwalzlinienlinie nach einem der Ansprüche 6 bis 9, wobei die bewegliche Warmwalzwärmeisolationswärmebehandlungsvorrichtung (40) ferner eine Gasschutzvorrichtung und einen Gassensor (8, 8') aufweist, die jeweils mit dem Informationsermittlungssteuermodul (7) elektrisch verbunden sind.

11. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach einem der Ansprüche 6 bis 10, wobei sich ein Signalausgabemodul in dem Informationsermittlungssteuermodul (7) befindet.

12. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach einem der Ansprüche 6 bis 11, wobei sich ein elektromagnetischer Block (114) auf einer Endfläche der Halteplatte (111) befindet und sich entsprechend ein Metallstopper, der zu dem elektromagnetischen Block (114) passt, zwischen Endabschnitten der zwei Haltekörper (21, 22) der Stahlrollenhalterung (2) an einer Seite befindet.

13. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach einem der Ansprüche 6 bis 12, wobei sich der Lagerträger (943) unter Verwendung einer Befestigungsplatte (945) an einer Seite des Haltekörpers (21, 22) befindet, wobei eine Seite der Befestigungsplatte (945) mit einem Durchgangsloch (9451) versehen ist, so dass sich die Stange (941) hindurch bewegen kann, und sich eine Walze (946), die gegen eine obere Oberfläche der Stange (941) stößt, an einer Außenseite der Befestigungsplatte (945) über dem Durchgangsloch (9451) befindet.

14. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach einem der Ansprüche 6 bis 13, wobei die Abdichtungsplatte (113) und das Abdichtungselement (93, 93') eine Verbundschichtstruktur aufweisen, wobei ein Zwischenteil der Struktur ein Isolierfilz ist, und wobei zwei Seiten des Zwischenteils mit einer hochtemperaturfesten Stahlplatte verkleidet sind.

15. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach einem der Ansprüche 6 bis 14, wobei sich eine Positionierungshülse (12) auf einem unteren Teil einer Seite des Wärmeisolationsgehäuses (4) befindet; wobei sich entsprechend ein Positionierungsstift (13), der zu der Positionierungshülse (12) passt, an dem Fach (3) für das Wärmeisolationsgehäuse (4) befindet; wobei der Positionierungsstift (13) vorzugsweise ein konusförmiger Körper ist.

16. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach einem der Ansprüche 6 bis 15, wobei das Wärmeisolationsgehäuse (4) mit einem Belüftungsloch und einem entsprechenden Auslassventil (41) versehen ist.

17. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach einem der Ansprüche 6 bis 16, wobei das Wärmeisolationsgehäuse (4) eine Verbundstruktur aufweist, aufweisend: eine äußere Schutzschicht, bei der es sich um eine hochfeste Stahlplatte handelt; eine Zwischenschicht, bei der es sich um ein Wärmeisolationsmaterial handelt, und eine Innenschicht, bei der es sich um eine hochtemperaturfeste Edelstahlplatte handelt.

18. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach einem der Ansprüche 6 bis 17, wobei das Wärmeisolationsgehäuse (4) eine Verbundstruktur ist, aufweisend eine innere Strahlungsschicht (42), eine Elektroheizdrahtschicht (43), eine Zwischengitterabdeckung (44), eine Zwischenwärmeisolationsschicht (45) und eine äußere Schutzschicht (46), in einer Reihenfolge von innen nach außen.

19. Mittlaufend beweglicher Wärmeisolations-Wärmebehandlungswarmwalzvorgang nach einem der Ansprüche 6 bis 18, wobei die elektrische Heizvorrichtung (5) ein Elektroheizdraht ist und der Temperatursensor (6) ein Thermoelementsensor ist.

Revendications

1. Procédé de traitement thermique et isolation thermique mobile en ligne de laminage à chaud, dans lequel une dalle est chauffée, laminée, refroidie par écoulement laminaire, et enroulée dans un état d'enroulement chaud ; après que l'enroulement chaud est déchargé et regroupé, un dispositif de traitement thermique et isolation thermique d'enroulement chaud mobile (40) est appliqué à l'enroulement chaud dans les 30 minutes pour démarrer un traitement thermique sur l'enroulement chaud alors que l'enroulement chaud est simultanément transporté en ligne vers une zone de traitement d'isolation thermique d'enroulement chaud ; après traitement thermique sur une durée de 1 à 48 heures, l'enroulement d'acier est refroidi dans l'air et ensuite envoyé vers un dépôt, dans lequel une température d'enroulement est contrôlée entre 250°C et 750°C, dans lequel le dispositif de traitement thermique et isolation thermique d'enroulement chaud mobile (40) comprend de plus :

une plaque de base (1),
une fixation d'enroulement d'acier (2) fournie sur une portion centrale d'une surface d'extrémité supérieure de la plaque de base (1) et
comprenant deux corps de support juxtaposés (21, 22), dans lequel des faces d'extrémité supérieures des deux corps de support (21, 22) sont des surfaces inclinées et sont disposées symétriquement, dans lequel un dispositif de scellement latéral (9, 9') est disposé sur un espace sur chacun des deux côtés des deux corps de support (21, 22), et dans lequel un dispositif de scellement de fond (11) est disposé entre les fonds des deux corps de support (21, 22) de la fixation d'enroulement d'acier (2) pour fermer l'espace entre les fonds des deux corps de support (21, 22),

le dispositif de scellement de fond comprenant (11) :

une plaque de support (111) fournie entre les deux corps de support (21, 22) de la fixation d'enroulement d'acier (2), dans lequel la plaque de support (111) est disposée verticalement, et plusieurs rouleaux (112) sont fournis sur des parties inférieures de deux côtés de la plaque de support (111) à espacements réguliers dans une direction de longueur pour former un mécanisme coulissable, et
une plaque de scellement (113) fournie horizontalement sur une surface supérieure de la plaque de support (111), dans lequel la plaque de scellement (113) présente une dimension correspondant à l'espace entre les fonds des deux corps de support (21, 22),

le dispositif de scellement latéral (9) comprenant :

deux plaques de base fixes (91, 91') chacune fournie horizontalement sur un fond de l'espace sur un côté extérieur des deux corps de support (21, 22) de la fixation d'enroulement d'acier (2), dans lequel plusieurs rouleaux de guidage (92, 92') espacés dans une direction axiale sont fournis sur une surface latérale extérieure de chacune des plaques de base fixes (91, 91'),
deux éléments de scellement (93, 92'), chacun disposé sur l'espace sur un des deux côtés des deux corps de support (21, 22) de la fixation d'enroulement d'acier (2), dans lequel une extrémité de fond de l'élément de scellement (93, 93') est fournie en pouvant coulisser sur les rouleaux de guidage (92, 92') de la plaque de base fixe (91, 91'), et
un mécanisme de commande (94) comprenant de plus deux crémaillères (941), chacune fournie horizontalement sur un des deux éléments de scellement (93, 93') avec une extrémité de la crémaillère (941) étant couplée à l'élément de scellement (93, 93'), et un arbre de commande (942), disposé horizontalement sur un côté du corps de support (21, 22) opposé à l'espace à travers deux supports de palier (943), deux engrenages (944), chacun fourni à une des deux extrémités de l'arbre de commande (942), dans lequel l'engrenage (944) forme un maillage avec la crémaillère (941),

un plateau (3) qui est une structure annulaire et disposé horizontalement par imbrication sur une partie milieu de la fixation d'enroulement d'acier (2),
une enceinte d'isolation thermique (4), qui présente une extrémité inférieure ouverte et une chambre interne ayant un volume supérieur à un enroulement d'acier (100), dans lequel l'enceinte d'isolation thermique (4) est disposée sur le plateau (3),
un dispositif de chauffage électrique (5) fourni sur une paroi latérale interne de l'enceinte d'isolation thermique (4),
un capteur de température (6) fourni dans l'enceinte d'isolation thermique (4), et un module de contrôle d'acquisition d'information (7),
dans lequel le dispositif de chauffage électrique (5) et le capteur de température (6) sont électriquement couplés au module de contrôle d'acquisition d'information (7).

2. Procédé de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon la revendication 1, dans lequel le dispositif de traitement thermique et isolation thermique d'enroulement chaud mobile (40) est appliqué à l'enroulement chaud dans les 10 minutes après que l'enroulement est achevé.

3. Procédé de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon la revendication 1 ou 2, dans lequel le dispositif de traitement thermique et isolation thermique d'enroulement chaud mobile (40) est un chariot de transport avec une enceinte d'isolation thermique (4).

4. Procédé de traitement thermique et isolation thermi-

que mobile en ligne de laminage à chaud selon l'une quelconque des revendications 1 à 3, dans lequel une vitesse de refroidissement naturel dans le dispositif de traitement thermique et isolation thermique d'enroulement chaud mobile (40) est de 1 à 10°C/h.

5. Procédé de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon l'une quelconque des revendications 1 à 4, dans lequel un système de chauffage et/ou un système de mise sous vide et/ou un système de remplissage de gaz inerte sont fournis dans le dispositif de traitement thermique et isolation thermique d'enroulement chaud mobile (40).

6. Procédé de traitement thermique et isolation thermique mobile en ligne de laminage à chaud, comprenant :

un banc de rouleau à chaîne de transport de traitement thermique (30) fourni entre un dispositif de regroupement (20) en aval d'un enrouleur d'acier laminé à chaud (10) et un ensemble de laminage à froid ;
au moins un dispositif de traitement thermique et isolation thermique d'enroulement chaud mobile (40) positionné sur le banc de rouleau à chaîne de transport de traitement thermique (30), le au moins un dispositif de traitement thermique et isolation thermique d'enroulement chaud mobile (40) comprenant de plus :

une plaque de base (1),
une fixation d'enroulement d'acier (2) fournie sur une portion centrale d'une surface d'extrémité supérieure de la plaque de base (1) et comprenant deux corps de support juxtaposés (21, 22), dans lequel des faces d'extrémité supérieure des deux corps de support (21, 22) sont des surfaces inclinées et sont disposées symétriquement, dans lequel un dispositif de scellement latéral (9, 9') est disposé sur un espace sur chacun des deux côtés des deux corps de support (21, 22), et dans lequel un dispositif de scellement de fond (11) est disposé entre des fonds des deux corps de support (21, 22) de la fixation d'enroulement d'acier (2) pour fermer l'espace entre les fonds des deux corps de support (21, 22),

le dispositif de scellement de fond (11) comprenant :

une plaque de support (111) fournie entre les deux corps de support (21, 22) de la fixation d'enroulement d'acier (2), dans lequel la plaque de support (111) est disposée verticalement, et plusieurs rouleaux (112) sont fournis sur des parties inférieures de deux côtés de la plaque de support (111) avec des espacements réguliers dans une direction de longueur pour former un mécanisme coulissable, et une plaque de scellement (113) fournie horizontalement sur une surface supérieure de la plaque de support (111), dans lequel la plaque de scellement (113) présente une dimension correspondant à l'espace entre les fonds des deux corps de support (21, 22),

le dispositif de scellement latéral (9) comprenant :

deux plaques de base fixes (91, 91') chacune fournie horizontalement sur un fond de l'espace sur un côté extérieur des deux corps de support (21, 22) de la fixation d'enroulement d'acier (2), dans lequel plusieurs rouleaux de guidage (92, 92') espacés dans une direction axiale sont fournis sur une surface latérale extérieure de chacune des plaques de base fixes (91, 91'),
deux éléments de scellement (93, 92'), chacun disposé sur l'espace sur un des deux côtés des deux corps de support (21, 22) de la fixation d'enroulement d'acier (2), dans lequel une extrémité de fond de l'élément de scellement (93, 93') est fournie en pouvant coulisser sur les rouleaux de guidage (92, 92') de la plaque de base fixe (91, 91'), et
un mécanisme de commande (94) comprenant de plus deux crémaillères (941), chacune fournie horizontalement sur un des deux côtés de scellement (93, 93') avec une extrémité de la crémaillère (941) étant couplée à l'élément de scellement (93, 93'), et un arbre de commande (942), disposé horizontalement sur un côté du corps de support (21, 22) opposé à l'espace à travers deux paliers de support (943), deux engrenages (944), chacun fourni à une des deux extrémités de l'arbre de commande

(942), dans lequel l'engrenage (944) forme un maillage avec la crémaillère (941),

un plateau (3) qui est une structure annulaire et disposé horizontalement par imbrication d'une partie milieu de la fixation d'enroulement d'acier (2),
une enceinte d'isolation thermique (4), qui présente une extrémité inférieure ouverte et une chambre interne ayant un volume supérieur à un enroulement d'acier (100), dans lequel l'enceinte d'isolation thermique (4) est disposée sur le plateau (3),
un dispositif de chauffage électrique fourni sur une paroi latérale interne de l'enceinte d'isolation thermique,
un capteur de température fourni dans l'enceinte d'isolation thermique, et un module de contrôle d'acquisition d'information, dans lequel le dispositif de chauffage électrique et le capteur de température sont électriquement couplés au module de contrôle d'acquisition d'information ;

de manière correspondante, un dispositif de levage (50, 50') capable de charger et décharger l'enroulement d'acier (100) jusqu'au dispositif de traitement thermique et isolation thermique d'enroulement chaud mobile (40) positionné à chaque extrémité du banc de rouleau à chaîne de transport de traitement thermique (30).

7. Ligne de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon la revendication 6, dans laquelle une zone d'isolation thermique d'enroulement d'acier (60) est fournie sur un côté du banc de rouleau à chaîne de transport de traitement thermique (30), et au moins un banc de rouleau à chaîne de transport d'isolation thermique (70) couplé au banc de rouleau à chaîne de transport de traitement thermique (30) est fourni dans la zone d'isolation thermique d'enroulement d'acier (60).

8. Ligne de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon la revendication 6 ou 7, dans laquelle au moins une station de travail de traitement thermique (80) est fournie sur le banc de rouleau à chaîne de transport de traitement thermique (30) ou le banc de rouleau à chaîne de transport d'isolation thermique (70), et un système de chauffage pour chauffer un intérieur de l'enceinte d'isolation thermique (4) dans le dispositif de traitement thermique et isolation thermique d'enroulement chaud mobile (40) et/ou un système d'entrée de gaz de refroidissement protecteur pour un refroidissement au gaz est/sont fourni/s dans la station de travail de traitement thermique (80).

9. Ligne de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon l'une quelconque des revendications 6 à 8, dans laquelle un dispositif d'impression de code d'information (90) pour l'impression d'information d'enroulement d'acier sur l'enroulement d'acier (100) est fourni à une extrémité du banc de rouleau à chaîne de transport de traitement thermique (30) faisant face à l'ensemble de laminage à froid.

10. Ligne de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon l'une quelconque des revendications 6 à 9, dans laquelle le dispositif de traitement thermique et isolation thermique d'enroulement chaud mobile (40) comprend de plus un dispositif de protection de gaz et un capteur de gaz (8, 8') qui sont électriquement couplés au module de contrôle d'acquisition d'information (7), respectivement.

11. Ligne de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon l'une quelconque des revendications 6 à 10, dans laquelle un module d'émission de signal est fourni dans le module de contrôle d'acquisition d'information (7).

12. Ligne de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon l'une quelconque des revendications 6 à 11, dans laquelle un bloc électromagnétique (114) est fourni sur une face d'extrémité de la plaque de support (111), et de manière correspondante, un butoir en métal s'adaptant au bloc électromagnétique (114) est fourni entre des portions d'extrémité des deux corps de support (21, 22) de la fixation d'enroulement d'acier (2) sur un côté.

13. Ligne de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon l'une quelconque des revendications 6 à 12, dans laquelle le palier de support (943) est fourni sur un côté du corps de support (21, 22) en utilisant une plaque de fixation (945), dans laquelle un côté de la plaque de fixation (945) est muni d'une perforation (9451) pour que la crémaillère (941) la traverse, et un rouleau (946) butant contre une surface supérieure de la crémaillère (941) est fourni sur un côté extérieur de la plaque de fixation (945) au-dessus de la perforation (9451).

14. Ligne de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon l'une quelconque des revendications 6 à 13, dans laquelle la plaque de scellement (113) et l'élément de scellement (93, 93') présentent une structure en couches

composite, dans laquelle une partie intermédiaire de la structure est un feutre d'isolation, et deux côtés de la partie intermédiaire sont revêtus avec une plaque d'acier résistant aux températures élevées.

15. Ligne de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon l'une quelconque des revendications 6 à 14, dans laquelle un manchon de positionnement (12) est fourni sur une partie inférieure d'un côté de l'enceinte d'isolation thermique (4) ; de manière correspondante, une pointe de positionnement (13) s'adaptant au manchon de positionnement (12) est fournie sur le plateau (3) pour l'enceinte d'isolation thermique (4) ; la pointe de positionnement (13) est de préférence un corps en forme de cône.

16. Ligne de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon l'une quelconque des revendications 6 à 15, dans laquelle l'enceinte d'isolation thermique (4) est munie d'un trou de ventilation et d'une vanne d'échappement correspondante (41).

17. Ligne de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon l'une quelconque des revendications 6 à 16, dans laquelle l'enceinte d'isolation thermique (4) présente une structure composite, comprenant : une couche de protection extérieure, laquelle est une plaque d'acier de résistance élevée ; une couche intermédiaire, laquelle est un matériau d'isolation thermique ; et une couche interne, laquelle est une plaque d'acier inoxydable résistant aux températures élevées.

18. Ligne de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon l'une quelconque des revendications 6 à 17, dans laquelle l'enceinte d'isolation thermique (4) est une structure composite, comprenant une couche de rayonnement interne (42), une couche de fil de chauffage électrique (43), une couverture de maillage intermédiaire (44), une couche d'isolation thermique intermédiaire (45), et une couche de protection extérieure (46) dans l'ordre allant de l'intérieur vers l'extérieur.

19. Ligne de traitement thermique et isolation thermique mobile en ligne de laminage à chaud selon l'une quelconque des revendications 6 à 18, dans laquelle le dispositif de chauffage électrique (5) est un fil de chauffage électrique, et le capteur de température (6) est un capteur de thermocouple.

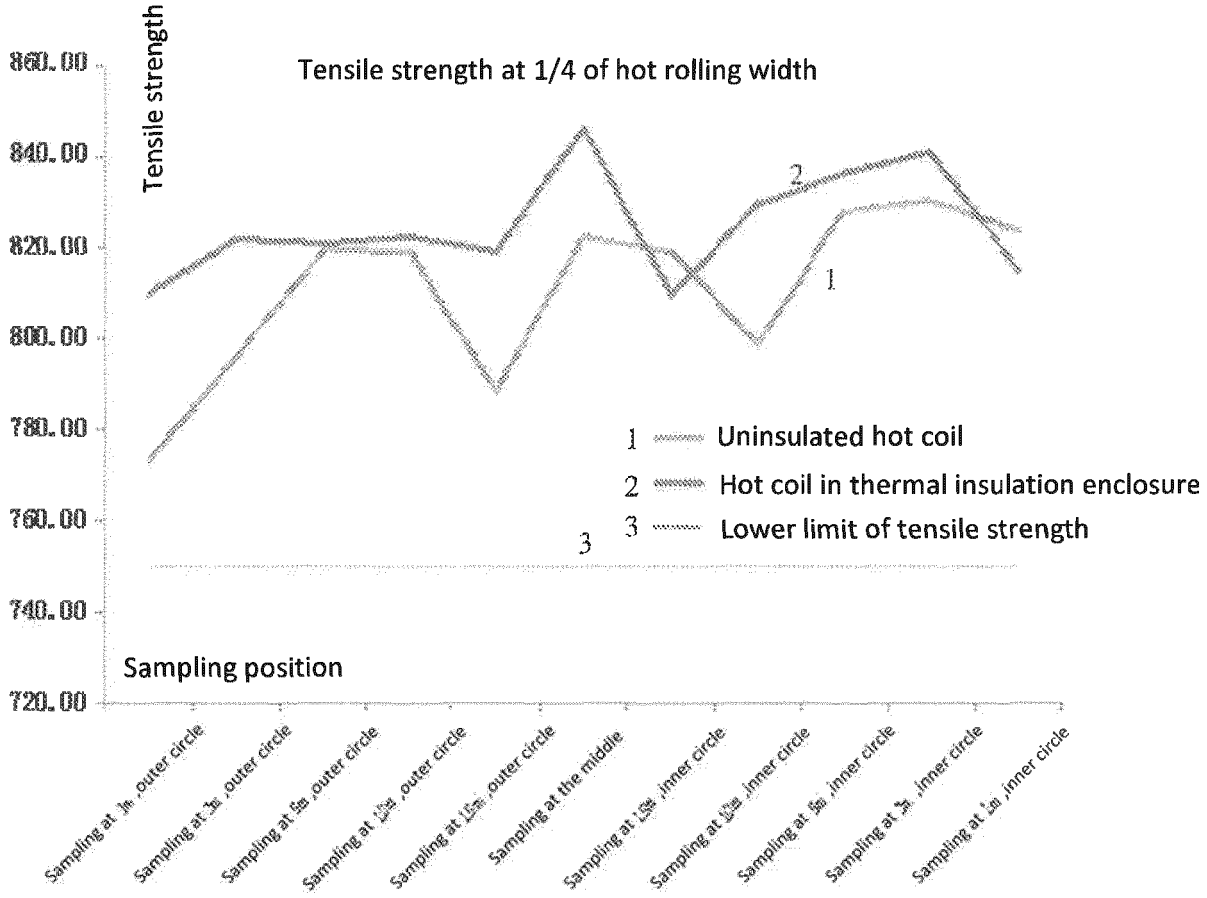
Tensile strength at 1/4 of hot rolling width
Tensile strength
860.00
840.00
820.00
800.00
780.00
760.00
740.00
720.00
Sampling position
1 Uninsulated hot coil
2 Hot coil in thermal insulation enclosure
3 Lower limit of tensile strength
Sampling at the middle

Fig.1

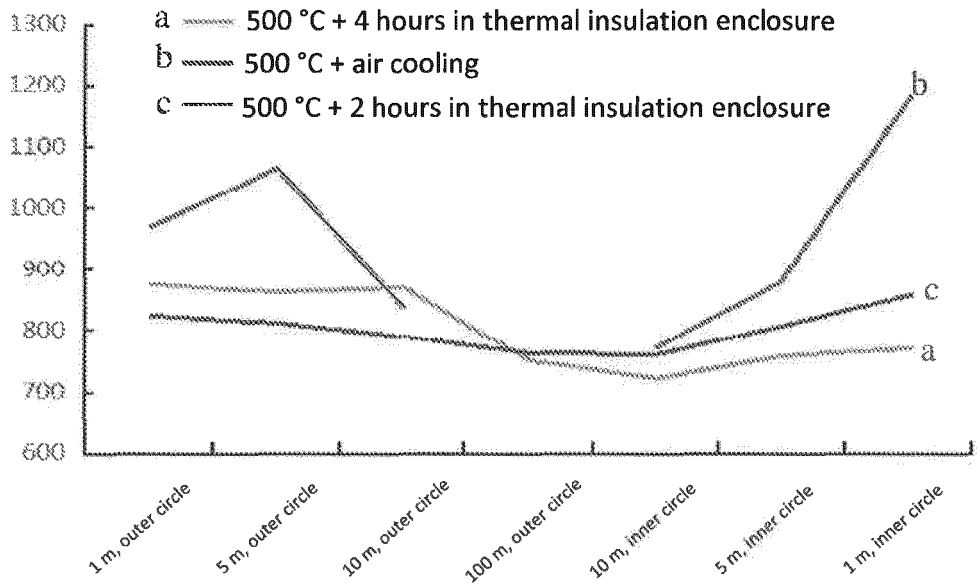
a 500 °C + 4 hours in thermal insulation enclosure
b 500 °C + air cooling
c 500 °C + 2 hours in thermal insulation enclosure
1300
1200
1100
1000
900
800
700
600
1 m, outer circle
5 m, outer circle
10 m, outer circle
100 m, outer circle
10 m, inner circle
5 m, inner circle
1 m, inner circle

Fig.2

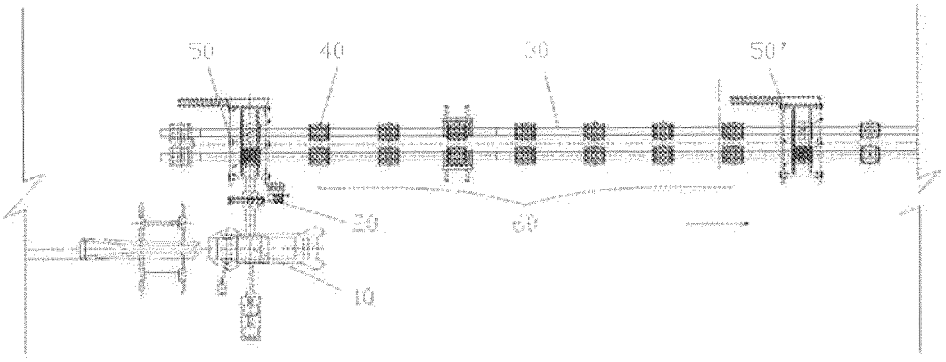

Fig.3

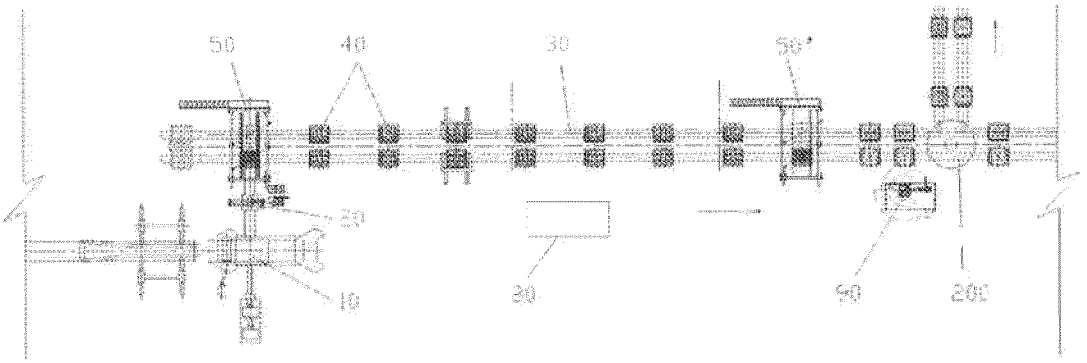

Fig.4

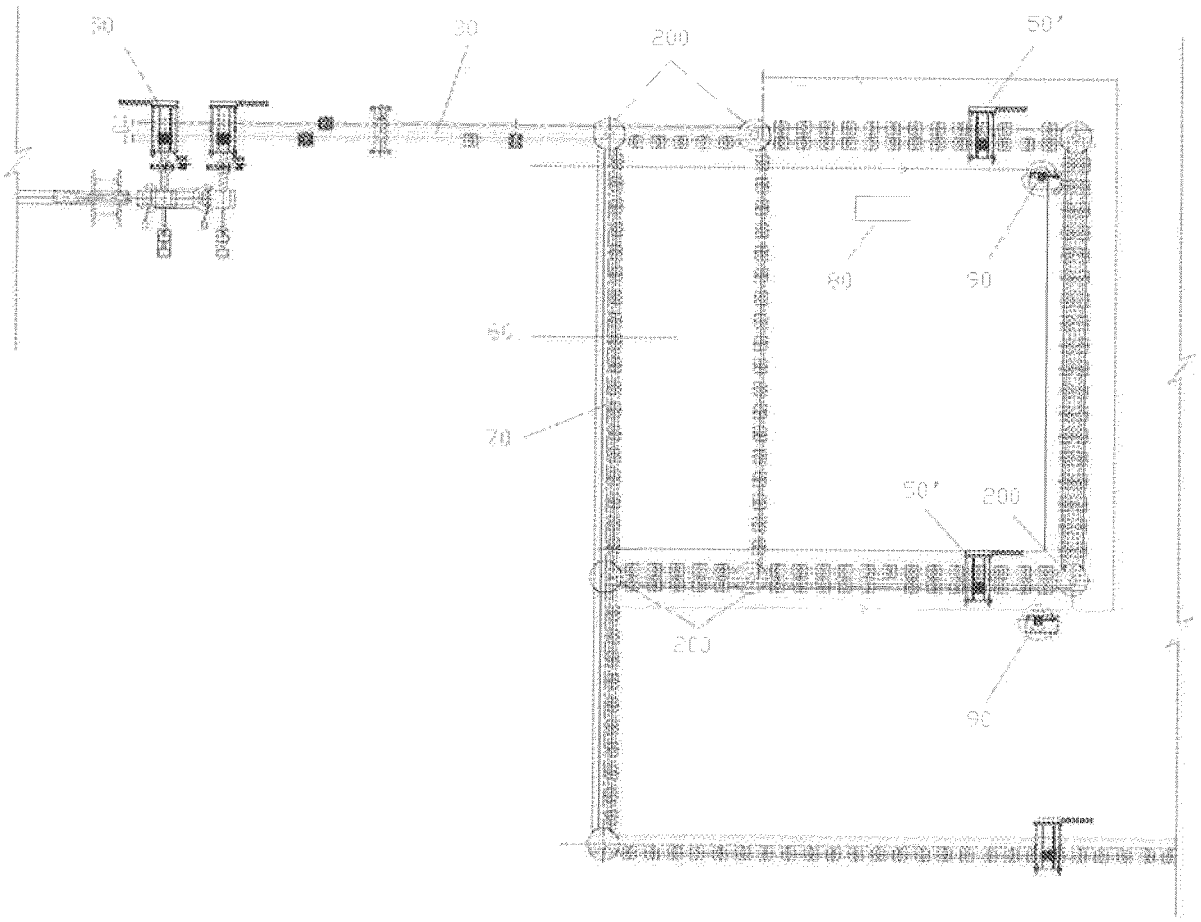

Fig.5

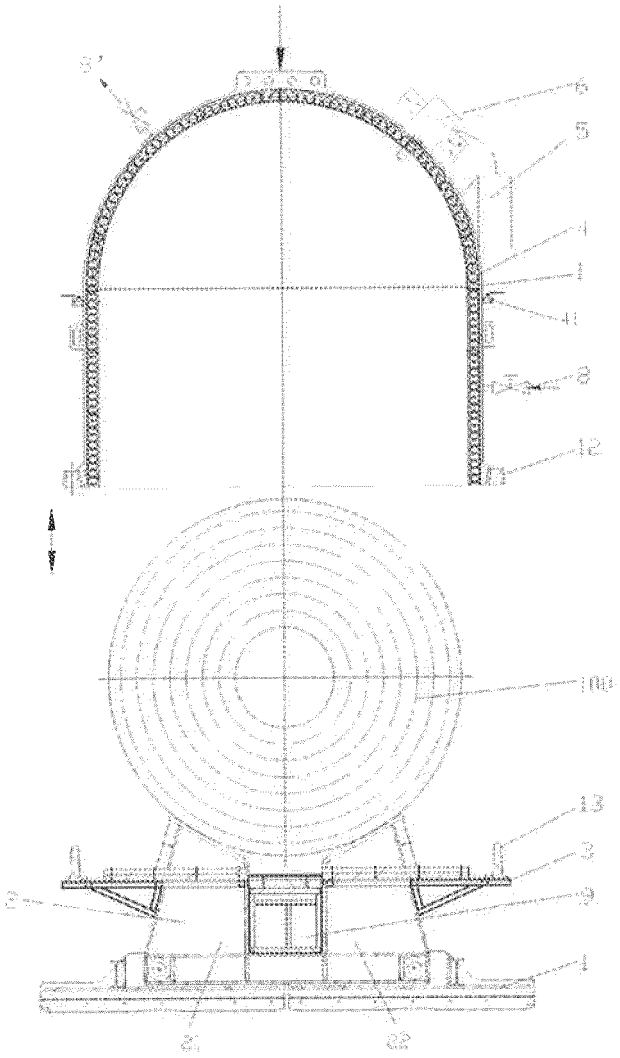

Fig.6

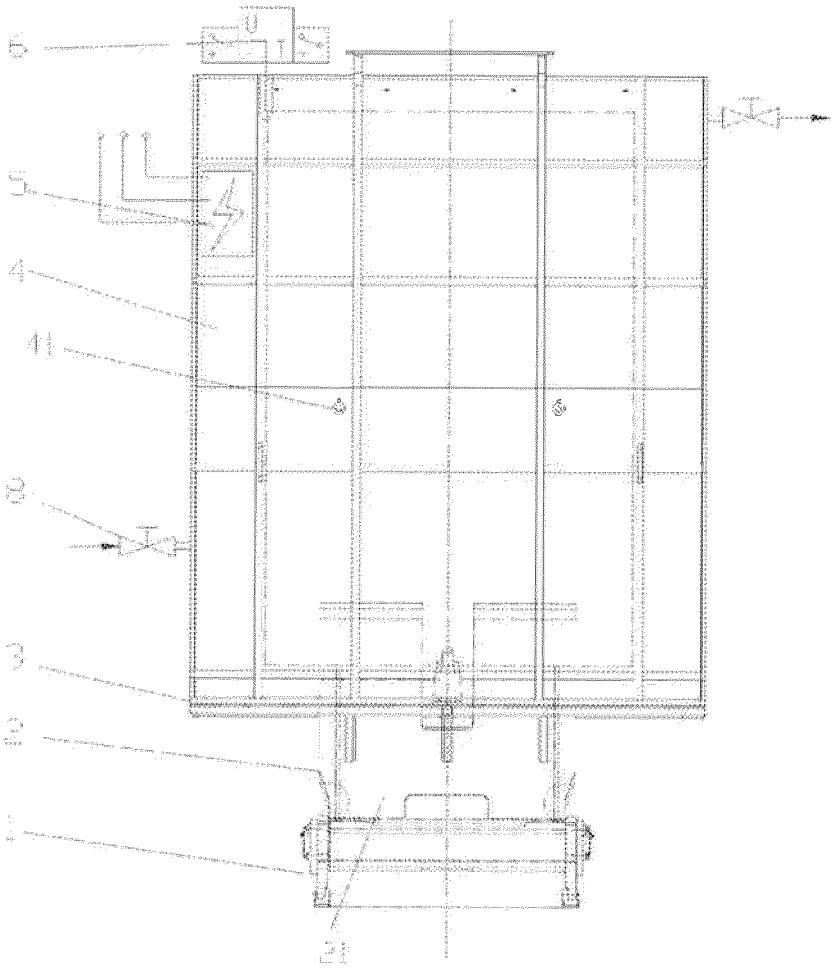

Fig.7

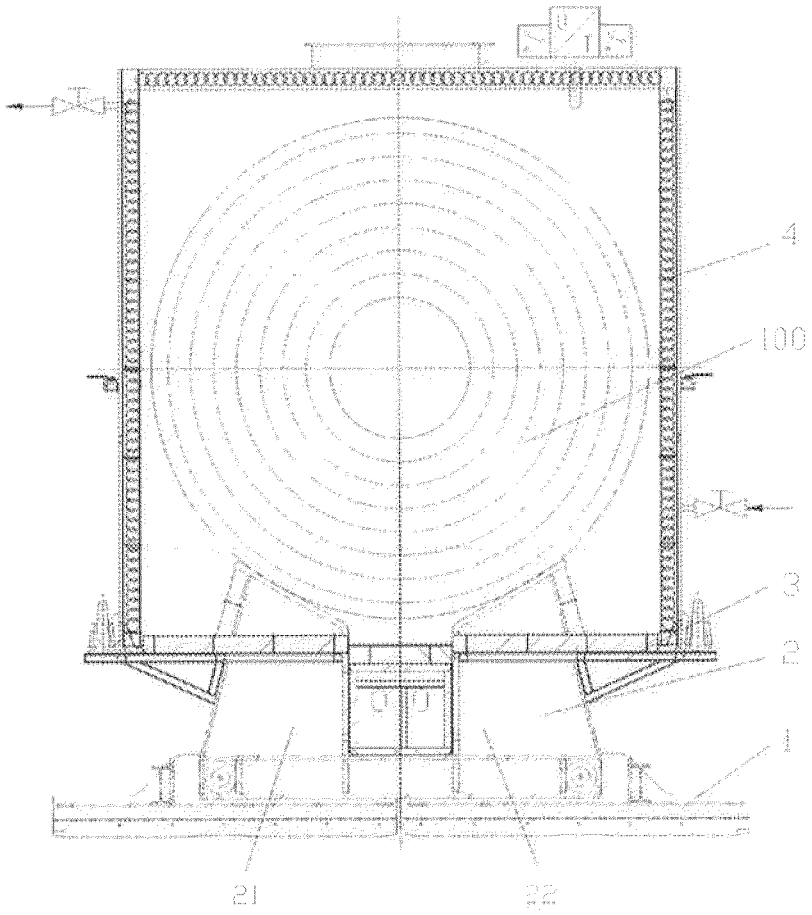

Fig.8

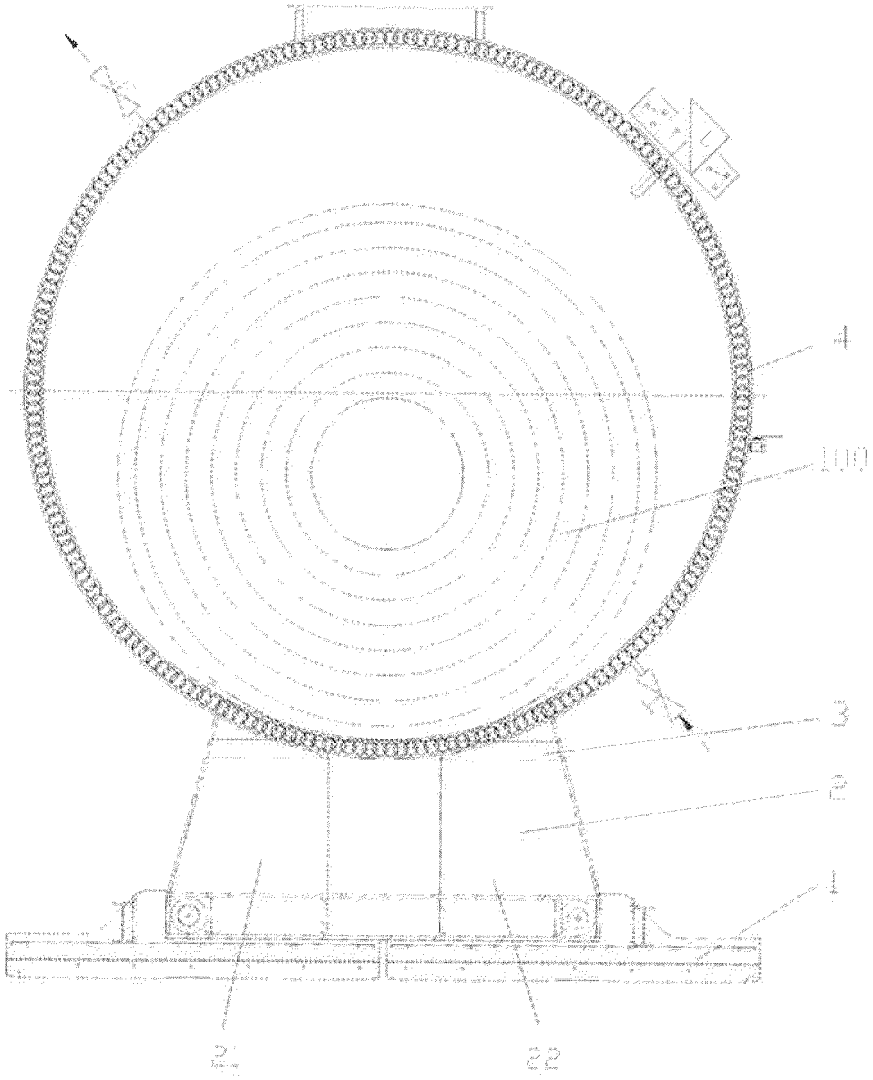

Fig.9

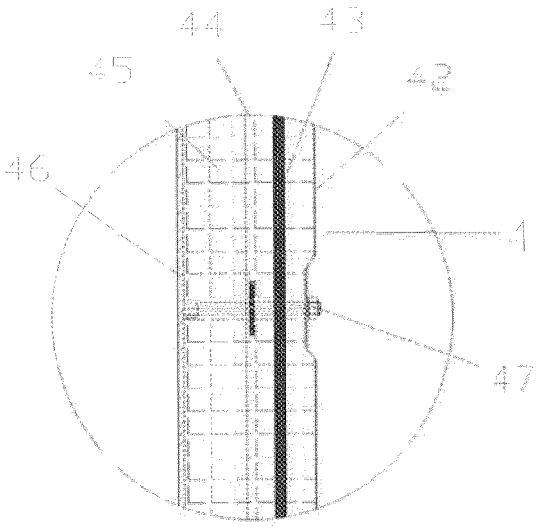

Fig.10

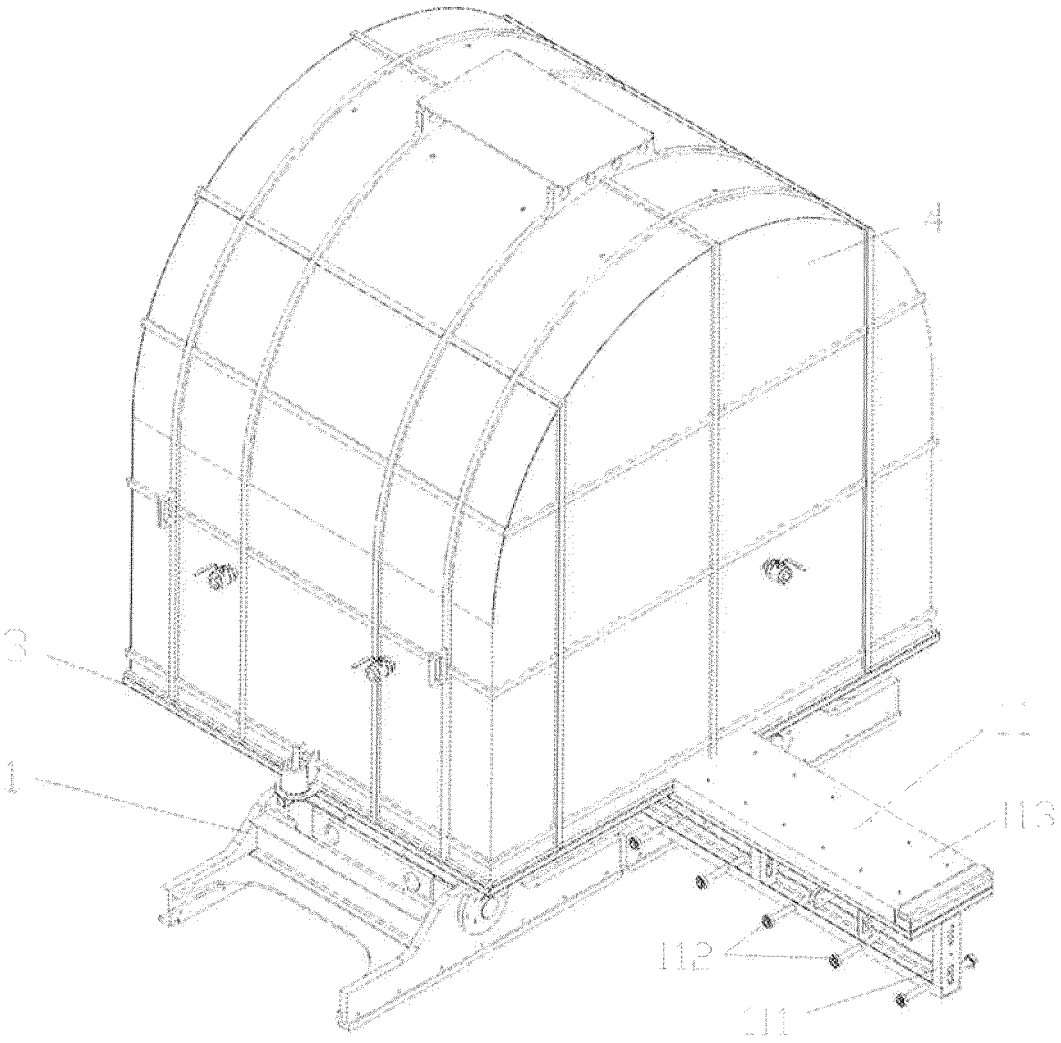

Fig.11

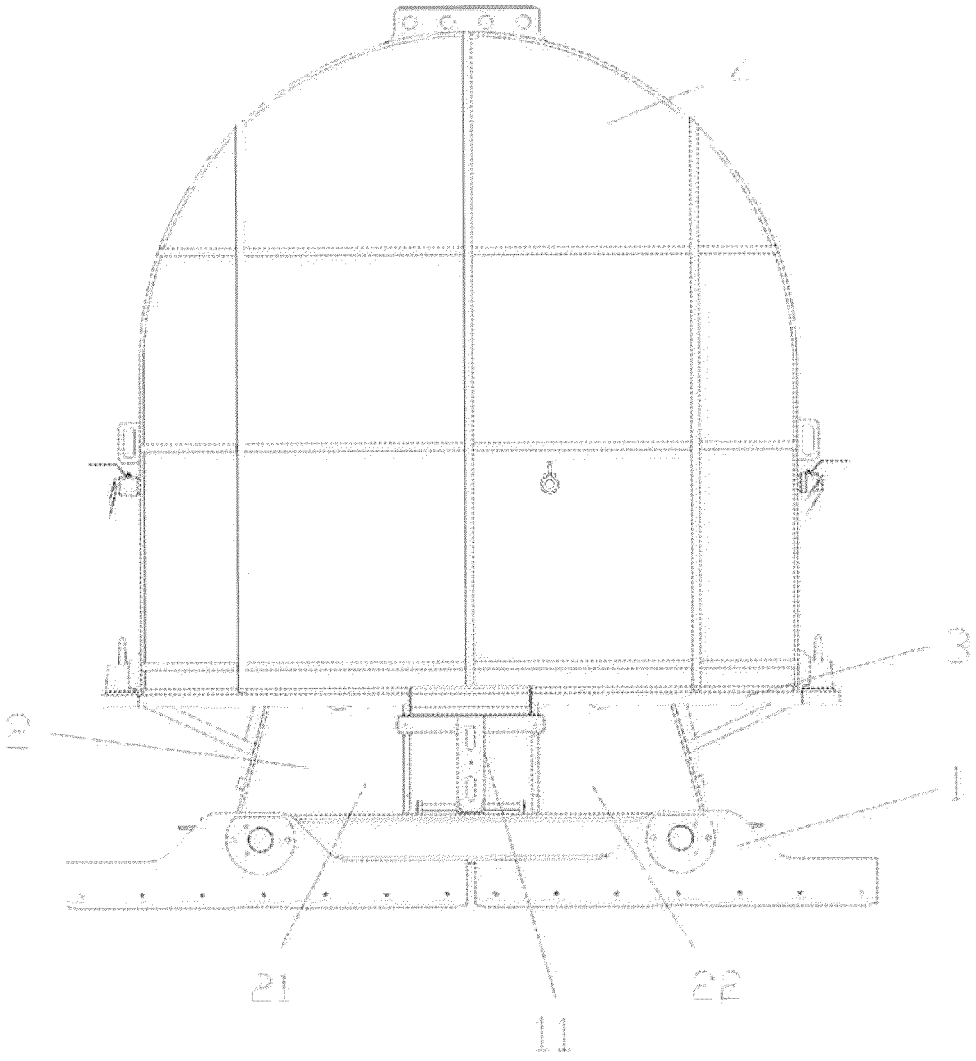

Fig.12

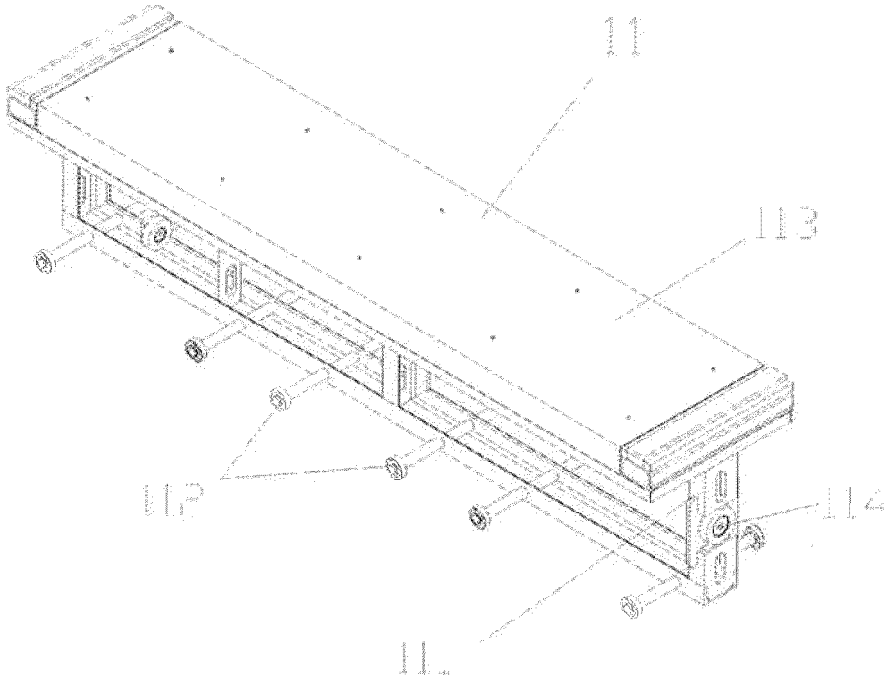

Fig.13

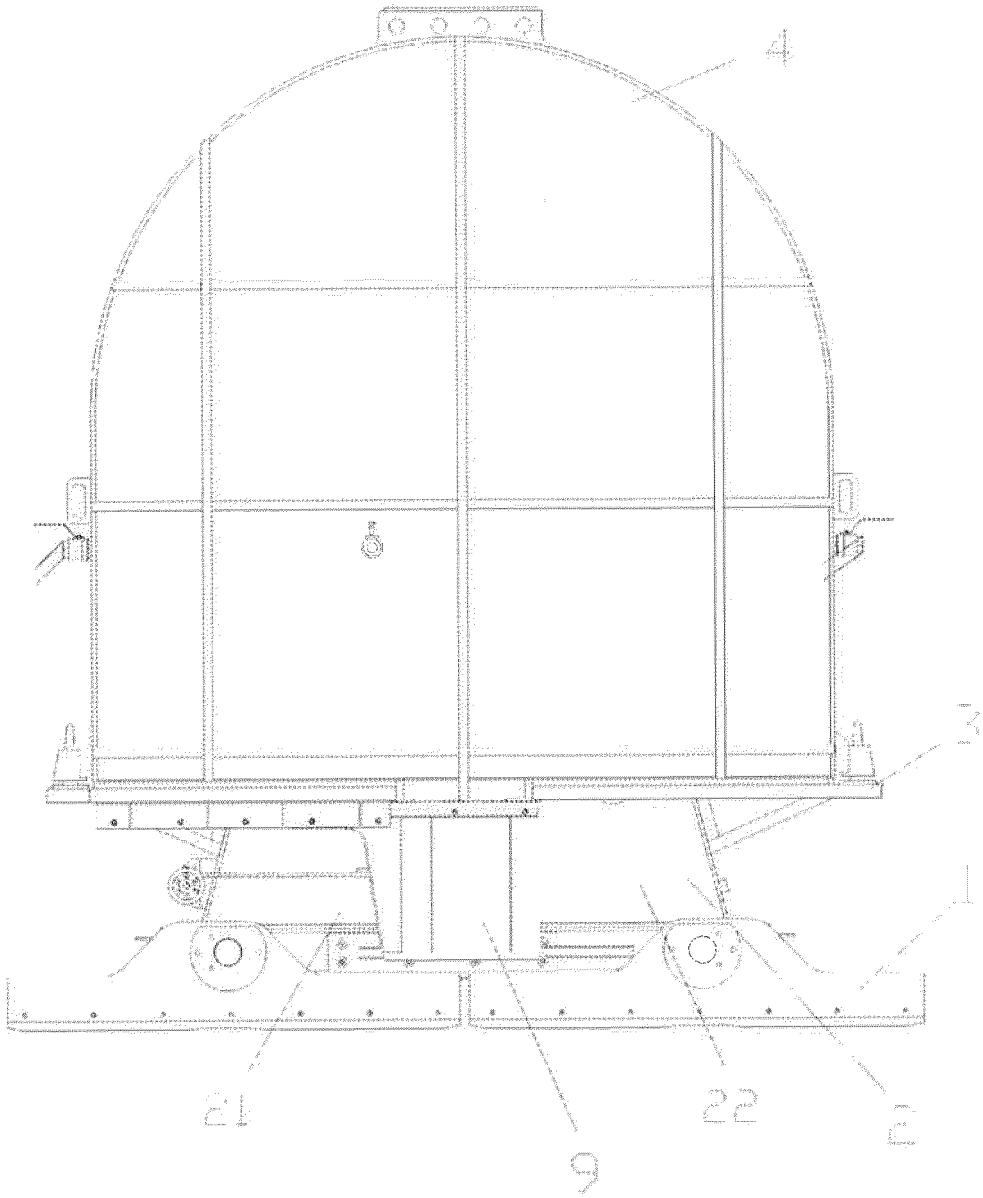

Fig.14

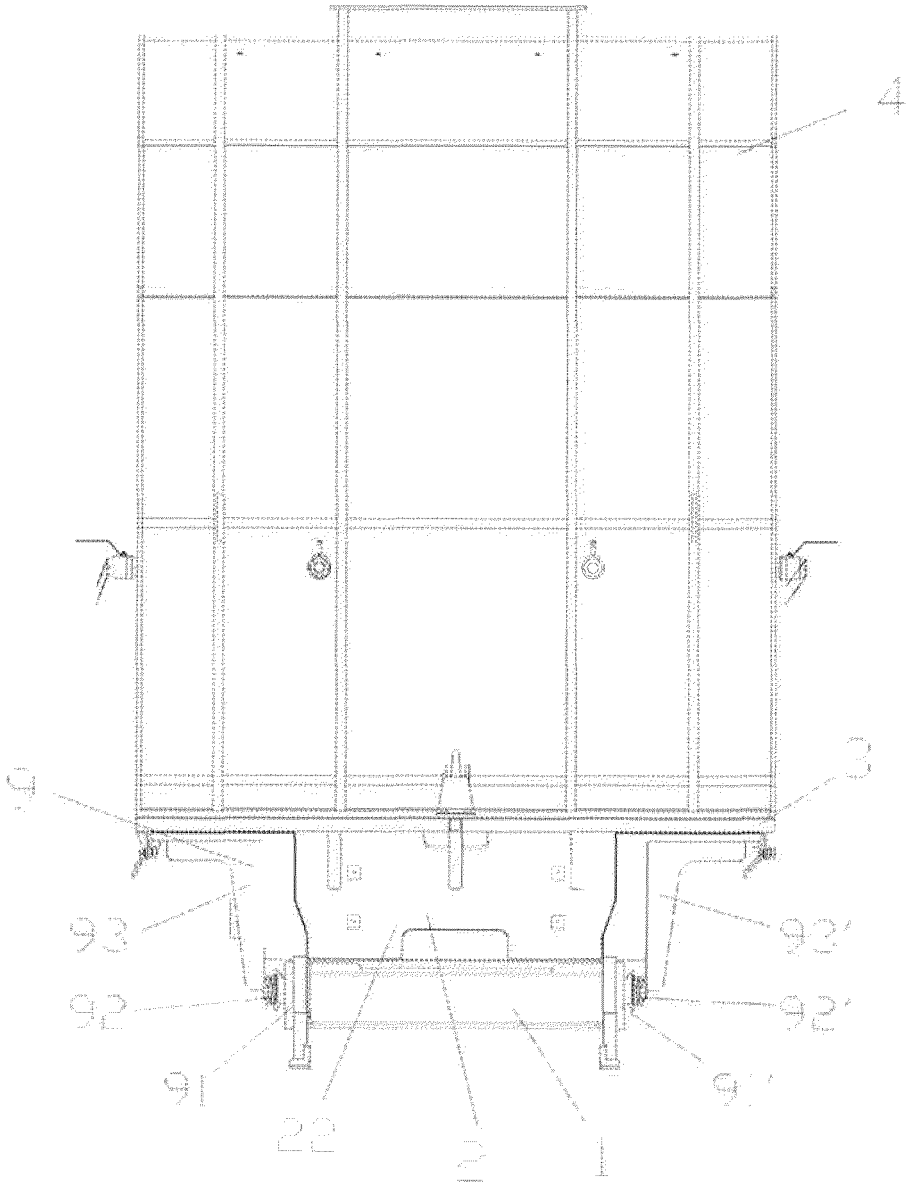

Fig.15

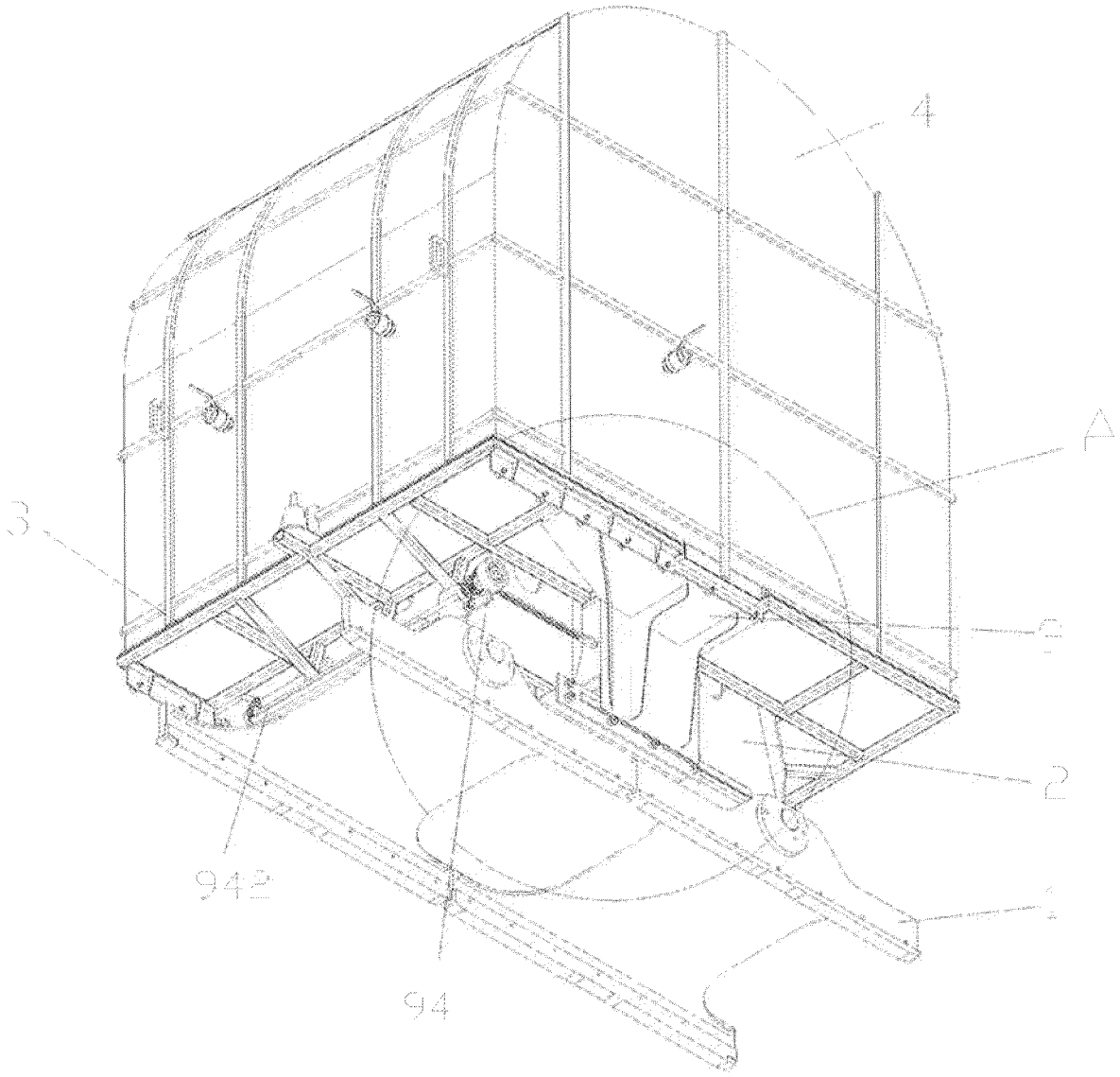

Fig.16

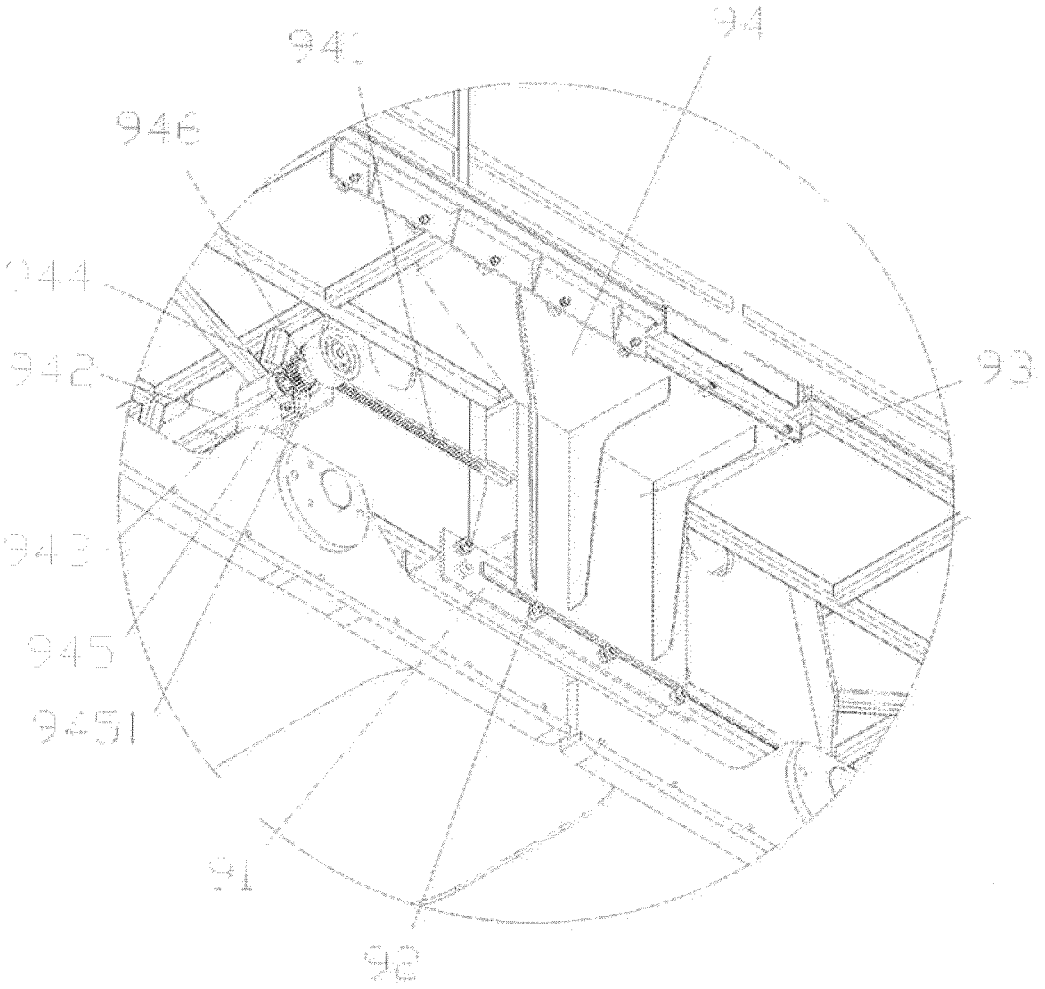

Fig.17

REFERENCES CITED IN THE DESCRIPTION

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