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(54) MOVABLE HOT ROLLING THERMAL INSULATION HEAT TREATMENT DEVICE

(57) A movable hot rolling thermal insulation heat treatment device, comprising: a base plate (1); a steel coil fixing base (2), disposed at the center on the base plate (1); a tray (3), which is of an annular structure and is horizontally fitted at the middle part of the steel coil fixing base (2); a thermal insulation cover (4), having an opening at the lower end and covering the tray (3), the inner cavity volume of the thermal insulation cover (4) being larger than the volume of a steel coil; an electric heating device (5) disposed on the inner side wall of the thermal insulation cover (4); a temperature sensor (6) disposed in the thermal insulation cover (4); and an information acquisition control module (7) electrically connected to the electric heating device (5) and the temperature sensor (6). The device can utilize the heat of a steel coil itself to perform a soaking and slow cooling heat treatment process on the steel coil, thereby achieving the purposes of high efficiency, energy conservation, and improvement of the yield.

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Description

Technical Field

[0001] The present disclosure relates to hot rolling equipment, in particular to a mobile hot coil thermal insulation heat treatment device.

Background Art

[0002] The production of cold-rolled ultra-high-strength steel mainly has the problem of large performance fluctuation in the length and width directions of the strip steel, which results in severe fluctuation in rolling force during cold rolling production and failure to meet the tolerance standard for the thickness of final cold-rolled products. Not only the rolling stability of cold-rolling - pickling - continuous rolling mills is influenced, but also the yield rate of cold-rolled ultra-high-strength steel is seriously affected.

[0003] The traditional hot rolling production line has only completed delivery of steel coils during the coil transportation after coiling. If the steel coils require thermal insulation, slow cooling, annealing and other treatment processes, special insulation pits, insulation furnaces, bell furnaces and heat treatment equipment need to be set up in the production line. This is characterized by large investment, high energy consumption, large transportation cost, low yield, etc. Especially for high-strength steel, the effect of the above processes cannot reach an ideal state due to aging.

[0004] At present, the mainstream steel plants at home and abroad mostly employ off-line thermal insulation pits, thermal insulation walls or thermal insulation furnaces to perform slow cooling and annealing on high-strength steel in an attempt to further cool the strip steel uniformly after coiling, so as to fulfil the purpose of reducing performance fluctuation and releasing internal stress. At the present stage, some companies have made certain staged development and application of movable hot coil annealing control devices, but there are many problems in use.

(1) The most prominent problem of a rolling line 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 and the like to such thermal insulation devices is generally high. Moreover, it takes a long period of time to retrofit the devices, 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 of this kind 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) At the present stage, the thermal insulation enclosures developed by some companies only have thermal insulation effect. Since the bottom structure cannot be sealed completely, the thermal insulation effect is not good for steel coils.

[0005] Chinese Patent Application CN201210338335 discloses a "carrier roller-tray type metal strip coil transport device", comprising a transport chain tray, wherein a steel coil is rolled up and transported 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.

[0006] Chinese Patent Application CN201710853613.3 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.

[0007] Japanese Patent Publication JP1985110816(A) discloses a "single-type thermal insulation enclosure", comprising a single-type thermal insulation enclosure, a form of roller bed transport chain structure, which can only achieve the thermal insulation effect for steel coils.

[0008] Japanese Patent Publication JP2010094710 (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.

Summary

[0009] An object of the present disclosure is to design a movable hot coil thermal insulation heat treatment device, which can use the heat of a steel coil itself to implement a 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.

[0010] To achieve the above object, the technical solution of the present disclosure is as follows:

There is provided a movable hot coil thermal insulation heat treatment device, comprising: a baseboard; a steel

coil fixture provided at a center of the baseboard; a tray which is an annular structure and horizontally arranged by nesting at a middle part of the steel coil fixture; a thermal insulation enclosure, which has an open lower end and an inner chamber having a volume larger than the steel coil, wherein the thermal insulation enclosure is arranged on the tray; 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.

[0011] Preferably, the movable hot coil thermal insulation heat treatment device further comprises a gas protection device and a gas sensor which are electrically coupled to the information acquisition control module, respectively.

[0012] Preferably, a signal emitting module is provided in the information acquisition control module.

[0013] Preferably, the steel coil fixture comprises two juxtaposed support bodies, wherein upper end faces of the two support bodies are inclined surfaces and are arranged symmetrically; and a side sealing device is arranged at a gap between the two support bodies at each of two sides of the two support bodies.

[0014] Further, a bottom sealing device is arranged between bottoms of the two support bodies of the steel coil fixture to close the gap between the bottoms of the two support bodies.

[0015] Preferably, the bottom sealing device comprises a support plate provided between the two support bodies of the steel coil fixture, wherein the support plate is arranged vertically, and a plurality of rollers are provided on lower parts of two sides of the support plate at even spacings in a length direction to form a slidable mechanism; and a sealing plate provided horizontally on a top surface of the support plate, wherein the sealing plate has a size corresponding to the gap between the bottoms of the two support bodies.

[0016] Preferably, an electromagnetic block is provided on an end face of the support plate, and correspondingly, a metal stopper matching the electromagnetic block is provided between end portions of the two support bodies of the steel coil fixture at one side.

[0017] Preferably, the sealing plate has a composite layered structure, wherein an intermediate part of the structure consists of an insulating felt, and two side parts are high temperature resistant steel plates.

[0018] Preferably, the side sealing devices comprise: two fixed baseboards, each arranged horizontally at a bottom of the gap at an outer side of the two support bodies of the steel coil fixture; a plurality of guide rollers spaced in an axial direction are provided on an outer side surface of each of the fixed baseboards; two sealing members, each arranged at the gap at one of the two sides of the two support bodies of the steel coil fixture, wherein a bottom end of the sealing member is provided slidably on the guide rollers of the fixed baseboard; and a driving mechanism, comprising: two racks, each provided horizontally on one of the two sealing members with one end of the rack being coupled to the sealing member; a drive shaft, arranged horizontally at a side of the support body opposite to the gap through two bearing pedestals; two gears, each provided at one of two ends of the drive shaft, wherein the gear meshes with the rack.

[0019] Preferably, the bearing pedestal is provided on one side of the support body by using a fixing plate, wherein one side of the fixing plate is provided with a through hole for the rack to pass through, and a roller abutted against a top surface of the rack is provided at an outer side of the fixing plate above the through hole.

[0020] Preferably, the sealing plate has a composite layered structure, wherein an intermediate part of the structure consists of an insulating felt, and two sides of the intemediate part are cladded with a high temperature resistant steel plate.

[0021] Preferably, the sealing member is a right angle plate structure.

[0022] Preferably, a positioning sleeve is provided on a lower part of a side of the thermal insulation enclosure. Correspondingly, a positioning pin matching the positioning sleeve is provided on the tray for the thermal insulation enclosure. The positioning pin is preferably a cone-shaped body.

[0023] Preferably, the thermal insulation enclosure is provided with a ventilation hole and a corresponding exhaust valve.

[0024] Preferably, the thermal insulation enclosure 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.

[0025] Preferably, the thermal insulation enclosure is a composite structure, comprising an inner radiation layer, an electric heating wire layer, an intermediate mesh cover, an intermediate thermal insulation layer, and an outer protection layer in order from inside to outside; wherein the composite structure of the thermal insulation enclosure is fixed with an anchor nail.

[0026] Regarding material, the inner layer is a high temperature resistant stainless steel plate.

[0027] Preferably, the thermal insulation enclosure is a square thermal insulation enclosure or a circular thermal insulation enclosure.

[0028] Preferably, the electric heating device is an electric heating wire, and the temperature sensor is a thermocouple.

[0029] The side sealing device mainly serves to enhance sealing performance, and prevent heat loss from the inner thermal insulation space after the thermal insulation enclosure is installed on the tray. After the sealing performance is increased, utilization of the residual heat of the steel coil in the sealed space is promoted.

[0030] The heat loss from the thermal insulation device

is reduced; the stability of the temperature insulation is increased; the accuracy of data measurement is guaranteed; the air tightness of the thermal insulation device is ensured; oxidation of the objects inside the thermal insulation device is prevented; and the level of automatic operation is enhanced. Therefore, the performances of the steel coil are improved.

[0031] The bottom sealing device closes the opening at the bottom. When the steel coil is unloaded from the coiler cavity onto the tray and the object to be thermally insulated is put in place, the thermal insulation enclosure is applied. During travel, the device automatically moves horizontally so that the opening at the bottom of the tray is sealed tightly to form a closed space to ensure that the heat will not be lost, and thermal insulation is achieved.

[0032] The base of the thermal insulation enclosure on the transport chain tray is located on the upper part of the transport chain tray, and is integrally welded to the transport chain tray. In order to increase the bearing capacity for the thermal insulation enclosure, the base of the thermal insulation enclosure on the transport chain tray is made of a high-strength steel material coated with a thermal insulation material. A high temperature resistant stainless steel plate is laid on the outermost part after a middle anchor nail is fixed. In order to ensure that the thermal insulation enclosure can be hoisted up and down conveniently, a positioning pin shaft and a guide sleeve are designed at the central position of the base of the thermal insulation enclosure on the transport chain tray. During the hoisting and installation process, the thermal insulation enclosure is finally aligned. Therefore, the positioning precision is increased, and the installation time is reduced.

[0033] When the steel coil is unloaded from the coiler cavity onto the tray, the thermal insulation enclosure is positioned and closed with the aid of positioning pins and positioning sleeves, so that the thermal insulation enclosure can be quickly installed and positioned to form a closed space to ensure that the heat will not be lost.

[0034] After the steel coil that has been coiled as a hot coil is placed on the transport chain tray and covered with the thermal insulation enclosure device, the gas protection device is used to protect the steel coil from oxidation which will otherwise increase the surface mass of the steel coil. A protective gas is introduced into the thermal insulation enclosure to replace the air around the steel coil. Oxidation of the steel coil and increase of the surface mass of the steel coil can thus be prevented.

[0035] A ventilation hole through the thermal insulation enclosure is arranged, and an exhaust valve is installed. After the steel coil that has been coiled as a hot coil is placed on the transport chain tray and covered with the thermal insulation enclosure device, the temperature in the internal space is 600 °C or higher. In addition, while the strip steel is coiled and the steel coil is cooled by laminar flow, a small amount of water vapor is adhered to the surface of the steel coil. In order to ensure the safety of the equipment and improve the quality of the steel coil, the high-temperature gas is expelled before the protective gas is introduced into the thermal insulation enclosure.

[0036] Since the thermal insulation enclosure has to be hoisted frequently, the outer layer of the thermal insulation enclosure is a high-strength steel plate to guarantee its strength for hoisting. The exterior is made of special high temperature resistant steel. A thermal insulation material is laid in the middle. After the middle anchor nail is fixed, a high temperature resistant stainless steel plate is laid as the innermost layer. To ensure hoisting at a later stage, a suction cup for hoisting is added on the top of the thermal insulation enclosure. At the same time, in view of the nature and type of the steel coil, the thermal insulation enclosure can be made into other forms (square thermal insulation enclosure structure, circular thermal insulation enclosure structure). A change of the temperature field structure is more conducive to improving the performances of the steel coil.

[0037] The electric heating device not only enables the thermal insulation enclosure to make use of the residual heat of the hot-rolled steel coil to achieve slow cooling, but also enables secondary heat treatment on some special steel materials to implement secondary tempering to improve the performances of the steel coil and refine grains.

[0038] The information detecting and sending module records the temperature of the steel coil in the thermal insulation enclosure. A detecting element, a PLC system and a wireless emitting device may be added on the thermal insulation enclosure to identify the information in the thermal insulation enclosure. A thermocouple measuring temperatures in the range of 0-1100 degrees is implanted inside the thermal insulation enclosure for detecting the temperature change of the air inside the thermal insulation enclosure.

[0039] In order to transmit data such as air temperature and the like in the thermal insulation enclosure to a ground server, and also transmit data and information related with the steel coil to downstream, a wireless remote control box may be installed on the outer surface of the original thermal insulation enclosure, wherein, with the aid of the wireless function and the power storage device, functions such as mobile temperature measurement and sampling of the thermal insulation enclosure, wireless data transmission, and logistics information writing and reading are implemented.

[0040] The beneficial effects of the present disclosure include:

The semi-circular structure design of the present disclosure has the characteristics of light structure weight, good thermal insulation effect, convenient steel coil loading and unloading, high degree of automation, good airtightness, etc., and has further optimized the equipment's thermal insulating, soaking and oxidation resisting effects.

1. The best effect can be achieved by implementing

thermal insulation shortly after coiling. When thermal insulation is implemented in a high temperature zone, performance indicators can be improved effectively. When thermal insulation is implemented in a low temperature zone, structure transformation or uneven cooling has already occurred, and thus the effect is greatly deteriorated.

2. Efficient insulation is a critical factor. Variation of cooling rate affects the material performances. "Laminar cooling + post-rolling cooling control" is an important link for improving the performances of a high-strength steel material. For different products, due to different compositions, treatment temperatures and processes, the material characteristics of hot coils also differ from each other.

3. Prolonged thermal insulation time is beneficial to homogenization and optimization of material performances. Thermal insulation time of ≥6 hours for 980QP, 980DP-GI (limit specification) and 1180QP hot coils, and thermal insulation time of ≥12 hours for 980CP hot coils are the best.

Description of the Drawings

[0041]

Fig. 1 is a schematic view showing the structure of Example 1 according to the present disclosure.

Fig. 2 is a side view of Example 1 according to the present disclosure.

Fig. 3 is a front view of Example 2 according to the present disclosure.

Fig. 4 is a front view of Example 3 according to the present disclosure.

Fig. 5 is a partial cutaway view of the thermal insulation enclosure in the Examples according to the present disclosure.

Fig. 6 is a stereogram of Example 1 according to the present disclosure.

Fig. 7 is a front view of Example 1 according to the present disclosure.

Fig. 8 is a stereogram of the bottom sealing device in Example 1 according to the present disclosure.

Fig. 9 is a front view of Example 1 according to the present disclosure.

Fig. 10 is a side view corresponding to Fig. 9.

Fig. 11 is an upward stereogram of Example 1 according to the present disclosure.

Fig. 12 is an enlarged schematic view of part A in Fig. 11.

Detailed Embodiments

[0042] Referring to Figs. 1-12, the movable hot coil thermal insulation heat treatment device according to the present disclosure comprises:

a baseboard 1;

a steel coil fixture 2 provided at a center of the baseboard 1;

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 the steel coil 100, wherein the thermal insulation enclosure 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 within 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.

[0043] In addition, the device further comprises a gas protection device and gas sensors 8, 8' which are electrically coupled to the information acquisition control module 7, respecti vely.

[0044] Preferably, a signal emitting module is provided in the information acquisition control module 7.

[0045] Preferably, 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.

[0046] Still further, a bottom sealing device 10 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.

[0047] Preferably, the bottom sealing device 10 comprises:

a support plate 101 provided between the two support bodies 21, 22 of the steel coil fixture 2, wherein the support plate 101 is arranged vertically, and a plurality of rollers 102 are provided on lower parts of two sides of the support plate 101 at even spacings in a length direction to form a slidable mechanism; and

a sealing plate 103 provided horizontally on a top surface of the support plate 101, wherein the sealing plate has a size corresponding to the gap between the bottoms of the two support bodies 21, 22.

[0048] Preferably, an electromagnetic block 104 is provided on an end face of the support plate 101, and correspondingly, a metal stopper matching the electromagnetic block is provided between end portions of the two support bodies of the steel coil fixture at one side.

[0049] Preferably, the sealing plate 103 has a composite layered structure, wherein an intermediate part of the structure consists of an insulating felt, and two side parts

are high temperature resistant steel plates.

[0050] Preferably, 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 outer side surfaces 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.

[0051] Preferably, the bearing pedestal 943 is provided on one side of the support body 221 by using a fixing plate 944, 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 945.

[0052] 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.

[0053] Preferably, the sealing member 93 is a right angle plate structure.

[0054] 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.

[0055] Preferably, the thermal insulation enclosure 4 is provided with a ventilation hole and a corresponding exhaust valve 41.

[0056] 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.

[0057] 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.

[0058] Referring to Figs. 3 and 4, the thermal insulation enclosure 4 is a square thermal insulation enclosure or a circular thermal insulation enclosure.

[0059] Preferably, the electric heating device 5 is an electric heating wire, and the temperature sensor is a thermocouple.

[0060] The thermal insulation treatment of a strip steel coil after coiling according to the present disclosure 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 thermal ensulation-anealing device, and large performance fluctuations of the strip steel in the length and width directions.

[0061] 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 integrated in the thermal insulation enclosure can cooperate to achieve temperature control under necessary conditions.

Claims

1. A movable hot coil thermal insulation heat treatment device, comprising:

   a baseboard;
   a steel coil fixture provided at a center of the baseboard;
   a tray which is an annular structure and horizontally arranged by nesting at a middle part of the steel coil fixture;
   a thermal insulation enclosure, which has an open lower end and an inner chamber having a volume larger than the steel coil, wherein the thermal insulation enclosure is arranged on the tray;
   an electric heating device provided on an inner side wall of the thermal insulation enclosure;
   a temperature sensor provided within 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.

2. The movable hot coil thermal insulation heat treatment device according to claim 1, wherein the movable hot coil thermal insulation heat treatment device

further comprises a gas protection device and a gas sensor which are electrically coupled to the information acquisition control module, respectively.

3. The movable hot coil thermal insulation heat treatment device according to claim 2, wherein a signal emitting module is provided in the information acquisition control module.

4. The movable hot coil thermal insulation heat treatment device according to claim 1, wherein the steel coil fixture comprises two juxtaposed support bodies, wherein upper end faces of the two support bodies are inclined surfaces and are arranged symmetrically; and a side sealing device is arranged at a gap at each of two sides of the two support bodies.

5. The movable hot coil thermal insulation heat treatment device according to claim 4, wherein a bottom sealing device is arranged between bottoms of the two support bodies of the steel coil fixture to close the gap between the bottoms of the two support bodies.

6. The movable hot coil thermal insulation heat treatment device according to claim 4, wherein the side sealing devices comprise:

two fixed baseboards each provided horizontally at a bottom of the gap at an outer side of the two support bodies of the steel coil fixture, wherein a plurality of guide rollers spaced in an axial direction are provided on an outer side surface of each of the fixed baseboards;
two sealing members, each arranged at the gap at one of the two sides of the two support bodies of the steel coil fixture, wherein a bottom end of the sealing member is provided slidably on the guide rollers of the fixed baseboard; and
a driving mechanism, comprising:

two racks, each provided horizontally on one of the two sealing members with one end of the rack being coupled to the sealing member; and
a drive shaft, arranged horizontally at a side of the support body opposite to the gap through two bearing pedestals; two gears, each provided at one of two ends of the drive shaft, wherein the gear meshes with the rack.

7. The movable hot coil thermal insulation heat treatment device according to claim 6, wherein the bearing pedestal is provided on one side of the support body by using a fixing plate, wherein one side of the fixing plate is provided with a through hole for the rack to pass through, and a roller abutted against a top surface of the rack is provided at an outer side of the fixing plate above the through hole.

8. The movable hot coil thermal insulation heat treatment device according to claim 6, wherein the sealing member has a composite layered structure, wherein an intermediate part of the structure consists of an insulating felt, and two sides of the intermediate part are cladded with high temperature resistant steel plates.

9. The movable hot coil thermal insulation heat treatment device according to claim 6 or 8, wherein the sealing member is a right angle plate structure.

10. The movable hot coil thermal insulation heat treatment device according to claim 5, wherein the bottom sealing device comprises:

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

11. The movable hot coil thermal insulation heat treatment device according to claim 10, wherein an electromagnetic block is provided on an end face of the support plate, and correspondingly, a metal stopper matching the electromagnetic block is provided between end portions of the two support bodies of the steel coil fixture at one side.

12. The movable hot coil thermal insulation heat treatment device according to claim 5, wherein the sealing plate has a composite layered structure, wherein an intermediate part of the structure consists of an insulating felt, and two side parts are high temperature resistant steel plates.

13. The movable hot coil thermal insulation heat treatment device according to claim 1, wherein a positioning sleeve is provided on a lower part of a side of the thermal insulation enclosure; correspondingly, a positioning pin matching the positioning sleeve is provided on the tray for the thermal insulation enclosure, wherein the positioning pin is preferably a cone-shaped body.

14. The movable hot coil thermal insulation heat treatment device according to claim 1, wherein the thermal insulation enclosure is provided with a ventilation

hole and a corresponding exhaust valve.

15. The movable hot coil thermal insulation heat treatment device according to claim 1, wherein the thermal insulation enclosure 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.

16. The movable hot coil thermal insulation heat treatment device according to claim 1, wherein the thermal insulation enclosure is a composite structure, comprising an inner radiation layer, an electric heating wire layer, an intermediate mesh cover, an intermediate thermal insulation layer, and an outer protection layer in order from inside to outside.

17. The movable hot coil thermal insulation heat treatment device according to claim 1, wherein the composite structure of the thermal insulation enclosure is fixed with an anchor nail.

18. The movable hot coil thermal insulation heat treatment device according to claim 1, wherein the thermal insulation enclosure is a square thermal insulation enclosure or a circular thermal insulation enclosure.

19. The movable hot coil thermal insulation heat treatment device according to claim 1, wherein the electric heating device is an electric heating wire, and the temperature sensor is a thermocouple.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2018/106712

A. CLASSIFICATION OF SUBJECT MATTER

C21D 9/52(2006.01)i; C21D 11/00(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)

C21D, B21B

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

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

CNABS, DWPI, SIPOABS, TWABS, CNKI: 宝钢湛江钢铁有限公司, 上海贺力液压机电有限公司, 钢, 轧, 保温, 热处理, 加热, 温度, 控制, 信息, 辊, hot, roll+, heat, preservat+, temprature, message, control+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 108441621 A (BAOSTEEL ZHANJIANG IRON & STEEL CO., LTD. ET AL.) 24 August 2018 (2018-08-24) claims 1-19	1-19
A	CN 206454997 U (CHEN, HUAIGANG) 01 September 2017 (2017-09-01) description, paragraphs [0003]-[0016], and figures 1-2	1-19
A	CN 103388067 A (WISDRI ENGINEERING & RESEARCH INCORPORATION LIMITED) 13 November 2013 (2013-11-13) entire document	1-19
A	JP 5658931 A (NIPPON STEEL CORP.) 22 May 1981 (1981-05-22) entire document	1-19
A	CN 202479223 U (XINXING DUCTILE IRON PIPES CO., LTD.) 10 October 2012 (2012-10-10) entire document	1-19

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

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Date of the actual completion of the international search	Date of mailing of the international search report
20 November 2018	**03 December 2018**
Name and mailing address of the ISA/CN **State Intellectual Property Office of the P. R. China** **No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088** **China** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2018/106712

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	108441621	A	24 August 2018	None			
CN	206454997	U	01 September 2017	None			
CN	103388067	A	13 November 2013	None			
JP	5658931	A	22 May 1981	US	4330111	A	18 May 1982
				BE	885513	A1	02 February 1981
				JP	S5855220	B2	08 December 1983
				DE	3039154	A1	07 May 1981
				GB	2062692	B	10 August 1983
				GB	2062692	A	28 May 1981
				SE	440233	B	22 July 1985
				DE	3039154	C2	22 September 1983
				SE	8007203	L	17 April 1981
CN	202479223	U	10 October 2012	None			

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 201210338335 **[0005]**
- CN 201710853613 **[0006]**
- JP 1985110816 A **[0007]**
- JP 2010094710 A **[0008]**