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(54) **LINE FOR AND METHOD OF HOT ROLLING A STEEL PLATE OR SHEET WITH PARTICULAR ARRANGEMENT OF COOLING EQUIPMENT**

LINIE UND VERFAHREN ZUM WARMEN ROLLEN VON STAHL PLATTE ODER BLECH MIT BESONDERER ANORDNUNG EINER KÜHLANLAGE

LIGNE ET METHODE DE LAMINAGE A CHAUD DE PLAQUE OU TOLE EN ACIER AVEC UN EQUIPEMENT DE REFROIDISSEMENT PARTICULIER

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(73) Proprietor: **JFE Steel Corporation**
Tokyo, 100-0011 (JP)

(72) Inventors:
- **NAKATA, Naoki**
  Tokyo 100-0011 (JP)
- **KUROKI, Takashi**
  Tokyo 100-0011 (JP)
- **FUJIBAYASHI, Akio**
  Tokyo 100-0011 (JP)
- **TOMITA, Shogo**
  Tokyo 100-0011 (JP)
- **NISHIDA, Shunichi**
  Toyko 100-0011 (JP)
- **HIRATA, Naoto**
  Toyko 100-0011 (JP)

(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

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Description

Technical Field

[0001] The present invention relates to a line for hot rolling a steel plate or sheet incorporating cooling equipment and a method of manufacturing the steel plate or sheet according to the preamble of claims 1 and 3 (see, for example, JP 60/166 413 U).

Background Art

[0002] In a process of manufacturing a steel plate or sheet by hot rolling, in general, cooling water is supplied or air-cooling is performed to control rolling temperature. In recent years, a technology that increases the strength of a steel plate or sheet as a result of obtaining a high cooling speed and forming a fine structure is being actively developed.

[0003] For example, as a technology for cooling a hot steel plate or sheet by supplying cooling water, the technology discussed in Japanese Unexamined Patent Application Publication No. 62-259610 is provided. In this technology, as shown in Fig. 7, a header 51, serving as an apron, is installed between table rolls 14, a plurality of holes, called multi-hole nozzles 52, are provided at the top surface of the header 51, and a rod-like water flow 53 is supplied from the multi-hole nozzles 52 to the under surface of a steel plate or sheet 10. Supplying a relatively large amount of cooling water to the steel plate or sheet allows a high cooling speed to be obtained.

[0004] As another technology for cooling a steel plate or sheet by supplying cooling water, the technology discussed in Japanese Unexamined Patent Application Publication No. 10-263669 is provided. In this technology, the steel plate or sheet can be efficiently cooled as a result of disposing nozzles in a honeycomb arrangement.

[0005] However, the technologies discussed in Japanese Unexamined Patent Application Publication Nos. 62-259610 and 10-263669 have serious problems in equipment maintainability, draining property after supplying the cooling water to the under surface of the steel plate or sheet, and cooling uniformity.

[0006] In the technology discussed in Japanese Unexamined Patent Application Publication No. 62-259610, since, as shown in Fig. 7, the header 51 of under-side cooling equipment 50 also serves as an apron between the table rolls 14, when the steel plate or sheet 10 having a downwardly curved edge enters, the steel plate or sheet 10 collides with the header 51, thereby breaking the header 51. If the nozzles 52 are crushed or deformed as a result of breaking the header 51, the cooling uniformity is considerably deteriorated. Therefore, when this technology is used for a long time, it has equipment maintainability problems unless, for example, the header (apron) 51 is frequently replaced.

[0007] In addition, when the cooling water 53 drops after being supplied to the steel plate or sheet 10, the cooling water 53 accumulates on the header (apron) 51, and forms a water film(or puddle) 54. Since the holes that are formed in the top surface of the header 51, serving as an apron, become the nozzles 52, newly supplied cooling water must break the water film(or puddle)54 for being supplied to the under surface of the steel plate or sheet 10. The larger the increase in the amount of cooling water, the thicker the water film (or puddle) 54 becomes, thereby reducing cooling efficiency.

[0008] Further, since the cooling water is drained through narrow gaps between the table rolls 14 and respective ends of the header (apron) 51, the drainage hinders the cooling using the newly supplied cooling water. Therefore, the cooling water cannot be efficiently used.

[0009] In the case where the technology discussed in Japanese Unexamined Patent Application Publication No. 10-263669 is used in cooling the under surface of the steel plate or sheet in a hot rolling line, when the steel plate or sheet having a downwardly curved edge enters, the steel plate or sheet collides with the nozzles, thereby breaking the nozzles. The edge of the steel plate or sheet may be prevented from colliding with the nozzles by installing a protector plate between the nozzles. However, since the nozzles are shifted by 1/2 pitch from each other in the widthwise direction and the direction of transferring of the steel plate or sheet, the interval between the nozzles is too narrow, thereby making it impossible to install a proper protector plate. Therefore, this can only be used in a process in which a material to be cooled does not collide with the nozzles. Consequently, this cannot be used in cooling the steel plate or sheet in a hot rolling line.

[0010] The present invention is achieved in view of the above-described circumstances, and has as its object the provision of steel plate or sheet cooling equipment which has good equipment maintainability, which has excellent draining property when supplying a large amount of cooling water to the under surface of a steel plate or sheet, and which performs efficient cooling uniformly in a widthwise direction, to achieve high cooling speed; and a method of manufacturing steel plate or sheet having high quality.

[0011] Reference is also made to JP 60 1664413 U and EP 1 527 829 A1.

Summary of the invention

[0012] The line and the method according to the present invention are defined by the independent claims 1 and 3 below. Dependent claims are directed to optional features and preferred embodiments.

[0013] In the present invention, since the tube-shaped nozzles that supply cooling water to the under surface of the steel plate or sheet are protected by the protector plates, even if the steel plate or sheet having a downwardly curved edge enters, the tube-shaped nozzles are prevented from being damaged, so that equipment maintainability is good. In addition, since the tube-shaped nozzles are disposed in a predetermined arrangement, even if a large amount of cooling water is supplied to the under surface of the steel plate or sheet, the cooling water is smoothly drained from gaps between the tube-shaped nozzles, so that draining property is excellent. As a result, efficient cooling is performed uniformly in the widthwise direction to achieve high cooling speed, so that the steel plate or sheet having high quality can be manufactured.

[0014] The cooling water supplied from the tube-shaped nozzles is defined in the application as a rod-like water flow. This rod-like water flow (also called a "columnar jet water flow") refers to a water flow jetted from spouts of the circular nozzles (including elliptical and polyangular nozzles). In addition, the rod-like water flow refers not to a spray jet, but to a continuous, rectilinear water flow whose cross section is maintained in a substantially circular form until the water flow collides with the steel plate or sheet from the spouts of the nozzles.

Brief Description of the Drawings

[0015]

Fig. 1 is a schematic view of a hot rolling line of a thin steel plate or sheet.
Fig. 2 illustrates cooling equipment according to an embodiment of the present invention.
Fig. 3 shows an exemplary disposition of nozzles of a header according to the embodiment of the present invention.
Fig. 4 shows another exemplary disposition of the nozzles.
Fig. 5 shows still another exemplary disposition of the nozzles.
Fig. 6 shows still another exemplary disposition of the nozzles.
Fig. 7 illustrates a related art.

Reference Numerals

[0016]

10 steel plate or sheet
11 reheating furnace
12 hot rolling mill
13 run out table
14 table roll
14a center of circular cross section of table roll
20 top-side cooling equipment
30 under-side cooling equipment
31 header
32 nozzle
33 cooling water
34 protector plate
35 protector plate
36 virtual line
50 under-side cooling equipment
51 header
52 nozzle spout
53 cooling water
54 water film (or puddle)

Best Mode for Carrying Out the Invention

[0017] An embodiment of the present invention will hereunder be described. Here, the case in which the present invention is applied to cooling of a steel plate or sheet at a run out table in a hot rolling line of the steel plate or sheet will be taken as an example, and discussed.

[0018] Fig. 1 is a schematic view of a hot rolling line of a thin steel plate or sheet that uses the present invention. Reference numeral 11 denotes a reheating furnace, reference numeral 12 denotes a hot rolling mill train comprising a rougher and a finisher, and reference numeral 13 denotes a run out table. Pieces of top-side cooling equipment 20 for supplying cooling water to the top surface of a steel plate or sheet 10 are installed at the upper portion of the run out table 13 so that they are separated by a predetermined interval in the direction of transferring of the steel plate or sheet 10 (hereafter simply referred to as "transferring direction"). Pieces of under-side cooling equipment 30 for supplying cooling water to the under surface of the steel plate or sheet 10 from gaps between table rolls 14 are installed at the lower portion of the run out table 13 so that they are separated by a predetermined interval in the transferring direction.

[0019] In the hot rolling line, the hot rolling mill train 12 performs roughing and finishing rolling on a slab that is extracted from the reheating furnace 11, to form the slab to a predetermined finishing plate or sheet thickness at a predetermined finishing temperature. Then, the slab is transfered to the run out table 13, and is cooled to a predetermined temperature by cooling water jetted from the pieces of the top-side cooling equipment 20 and the under-side cooling equipment 30.

[0020] Fig. 2 shows the under-side cooling equipment 30 according to the embodiment of the present invention. Fig. 3 is a plan view showing the disposition of nozzles of the under-side cooling equipment 30.

[0021] As shown in Figs. 2 and 3, the under-side cooling equipment 30 comprises a header 31, a plurality of protector plates 34, and nozzle trains. The protector plates 34 are disposed on the top surface of the header 31 obliquely with respect to the transferring direction. The nozzle trains are provided on the header 21 obliquely with respect to the transferring direction so that, here, two nozzle trains each are disposed between the protector plates 34 that are adjacent to each other. The nozzle trains have the same number of circular-tube-shaped nozzles 32 (here, one) disposed, respectively, on virtual lines 36 (broken line in Fig. 3) drawn at certain pitches in a plate or sheet width direction. The top end (front end) of each circular-tube-shaped nozzle 32 that jets a rod-like water flow is positioned below the top ends of the protector plates 34, and above a center 14a of a circular cross section of each table roll 14. The header 31 to which the circular-tube-shaped nozzles 32 are mounted is positioned below the center 14a of the circular cross section of each table roll 14. The inside diameter of each circular-tube-shaped nozzle 32 is 3 to 8 mm, and the jet speed is 1 to 10 m/s. It is desirable that the intervals between the protector plates 34 be equal to each other.

[0022] In the under-side cooling equipment 30 having the above-described structure, since the circular-tube-shaped nozzles 32 that supply a rod-like water flow 33 to the under surface of the steel plate or sheet 10 are protected by the protector plates 34, even if the steel plate or sheet having a downwardly curved edge enters, damage to the circular-tube-shaped nozzles 32 is prevented from occurring, so that equipment maintainability is good. Therefore, while the circular-tube-shaped nozzles 32 are in a good state, cooling can be performed over a long period of time. Consequently, it is possible to prevent the occurrence of strip temperature deviation of the steel plate or sheet, without, for example, repairing the equipment.

[0023] Since the circular-tube-shaped nozzles 32 are disposed in a predetermined arrangement, even if a large amount of cooling water 33 is supplied to the under surface of the steel plate or sheet, the cooling water is smoothly drained from the gaps between the circular-tube-shaped nozzles 32, so that draining property is excellent. Further, since the header 31 is positioned below the center 14a of the circular cross section of each table roll 14, the flow of the cooling water is not hindered between the header 31 and the table rolls 14, so that the cooling water is more smoothly drained. Therefore, the cooling water is not retained at the top surface of the header 31, so that spouts at ends of the circular-tube-shaped nozzles 32 are not submerged. Consequently, cooling water having high momentum is always supplied to the under surface of the steel plate or sheet 10, so that efficient cooling can be performed.

[0024] In the foregoing discussion, the ends of the circular-tube-shaped nozzles 32 are positioned above the center 14a of the circular cross section of each table roll 14 because, if the ends of the circular-tube-shaped nozzles 32 are separated too much from the under surface of the steel plate or sheet 10, a high jet pressure for supplying cooling water having high momentum to the under surface of the steel plate or sheet 10 is required due to the influence of falling cooling water.

[0025] The inside diameter of the circular-tube-shaped nozzles 32 is 3 to 8 mm due to the following reasons. If the inside diameter is less than 3 mm, nozzle clogging may frequently occur. In addition, since the jet flow is thin, the cooling water may not be capable of reaching the under surface of the steel plate or sheet 10 due to the interference of falling cooling water. Therefore, cooling performance is reduced. In contrast, if the inside diameter is greater than 8 mm, it is necessary to restrict the jet speed to a certain low value as a result of increasing the interval between the nozzles. Therefore, strip temperature deviation in the steel plate or sheet width direction is increased, and cooling performance is also reduced.

[0026] The jet speed from the circular-tube-shaped nozzles 32 is set from 1 to 10 m/s for the following reasons. If the jet speed is less than 1 m/s, the momentum with which the cooling water strikes the steel plate or sheet 10 is low, as a result of which cooling is not sufficiently performed. In contrast, if the jet speed is greater than 10 m/s, an extremely high fountain results, thereby causing the cooling water to fly to places surrounding the equipment.

[0027] The top-side cooling equipment 20 uses related cooling equipment including, for example, circular-tube-shaped nozzles.

[0028] Accordingly, since the steel plate or sheet 10 is cooled at the run out table 13 using the above-described under-surface cooling equipment 30, equipment maintainability and draining property are excellent, and efficient cooling is performed uniformly in the widthwise direction to achieve high cooling speed. Therefore, the steel plate or sheet having high quality can be manufactured.

[0029] Although, in the embodiment, the circular-tube-shaped nozzles 32 are used for the nozzles of the under-side cooling equipment 30, other tube-shaped nozzles, such as rectangular-tube-shaped nozzles, may also be used.

[0030] The disposition of the protector plates 34 and the circular-tube-shaped nozzles 32 is not limited to that shown in Fig. 3. As shown in Fig. 4, three nozzle trains each may be disposed between the protector plates 34 that are adjacent to each other, with one circular-tube-shaped nozzle 32 being disposed on respective virtual lines. Alternatively, as shown in Figs. 5 and 6, the nozzle trains may be divided in two in the transferring direction, and a protector plate 35 may be disposed between the divided rows in the steel plate or sheet width direction.

[0031] Further, the present invention may be used not only in a hot rolling line of a thin steel plate or sheet, but also in a hot rolling line of a thick steel plate.

Example

[0032] As an example according to the present invention, a steel sheet was cooled at the run out table 13 in the hot rolling line of the thin steel sheet schematically shown in Fig. 1. Here, the finishing temperature was 880°C, the finishing sheet thickness was 4 mm, and the cooling was performed at the run out table 13 up to a temperature of 550°C.

[0033] As the example according to the present invention, using the under-side cooling equipment 30 described in the above-described embodiment, a rod-like water flow was supplied to the under surface of the steel sheet. Here, steel sheets having a thickness of 22 mm were used for the protector plates 34, and the inside diameter of the circular-tube-shaped nozzles 32 was 6 mm.

[0034] As a comparative example, as shown in Fig. 7, a rod-like water flow was supplied to the under surface of the steel sheet 10 using the cooling equipment 50 discussed in Japanese Unexamined Patent Application Publication No. 62-259610 in which the header 51, which also serves as an apron, is installed between the table rolls 14.

[0035] In both the example according to the present invention and the comparative example, the current density of the cooling water supplied to the under surface of the steel sheet was 2 m^3/m^2min, and the distance between the nozzle spouts and the under surface of the steel sheet was 150 mm. In addition, in both cases, a rod-like water flow having a current density of 1 m^3/m^2min was supplied to the top surface of the steel sheet 10 using a related technology.

[0036] The results of comparisons between the example of the present invention and the comparative example in terms of equipment maintainability and draining property of the cooling water, and cooling performance are shown in Table 1. In Table 1, "x" stands for the case in which productivity and quality are reduced, and "O" stands for the case in which they are not reduced.

Table 1

	NOZZLES	DAMAGE TO EQUIPMENT	SUBMERGENCE OF SPOUTS OF NOZZLES OF COOLING WATER	COOLING SPEED	STRIP TEMPERATURE DEVIATION IN LONGITUDINAL DIRECTION	STRIP TEMPERATURE DEVIATION IN WIDTHWISE DIRECTION	DEVIATION OF MECHANICAL PROPERTIES
COMPARATIVE EXAMPLE	PERFORATED PLATE	× YES	× YES	20°C/s	× 30°C	× 30° C	× LARGE
EXAMPLE OF PRESENT INVENTION	CIRCULAR TUBE	○ NONE	○ NONE	30°C/s	○ 10°C	○ 10°C	○ SMALL

[0037] As shown in Table 1, in the comparative example, when the steel sheet having a downwardly curved edge entered, it collided with the top surface of the header serving as an apron, thereby damaging the equipment. This caused the top surface of the header 51 to be dented, and the spouts of the nozzles 52 to be deformed, as a result of which the jet direction of the cooling water 53 became ununiform, and the strip temperature deviation in the sheet width direction was sometimes as high as 30°C. In addition, costs for repairing damaged portions of the equipment were high, and productivity was often reduced due to stoppage of operation.

[0038] In addition, since the cooling water after being supplied to the under surface of the steel sheet 10 was drained from only the narrow gaps between the header 31 and the table rolls 32, the cooling water accumulated on the header (apron) 31, thereby forming the water film (or puddle) 54. The cooling water 53 jetted from the spouts of the nozzles 52 reached the under surface of the steel sheet 10 after its momentum was reduced by the water film (or puddle) 54. Therefore, efficient cooling was not performed, and the cooling speed resulting from combination of the cooling at the under surface and the cooling at the top surface was low at 20°C/s.

[0039] The water film (or puddle) 54 was not formed when an edge of the steel sheet 10 passed. It was formed some time after the passage of the edge. Therefore, only the edge of the steel sheet 10 was cooled well, and the temperature difference between edge parts and steady parts that are cooled after the formation of the water film (or puddle) 54 was as high as 30°C.

[0040] Accordingly, since the strip temperature deviation was large, the steel sheet (difference between its maximum strength and minimum strength: at least 3 kgf/mm^2) having a large deviation of mechanical properties, such as tensile strength, was manufactured.

[0041] In contrast, in the example of the present invention, when the steel sheet having a downwardly curved edge entered, the steel sheet only collided with the protector plates 34, so that the steel sheet did not further enter downward. Therefore, equipment including, for example, the circular-tube-shaped nozzles 32 was not damaged. This made it possible to perform cooling while the circular-tube-shaped nozzles 32 were in a good state, so that the strip temperature deviation in the sheet width direction could be reduced to within 10°C, without, for example, repairing the equipment. In addition, since the operation was not stopped, high productivity could be maintained.

[0042] Further, since the circular-tube-shaped nozzles 32 were disposed in a predetermined arrangement, and the header 31 was positioned below the center 14a of the circular cross section of each table roll 14, the cooling water was smoothly drained from the gaps between the circular-tube-shaped nozzles 32, and the flow between the header 31 and each table roll 14 was not hindered. Therefore, the cooling water was not retained at the top surface of the header 31, so that the spouts at the ends of the circular-tube-shaped nozzles 32 were not submerged. Consequently, the rod-like water flow 33 having momentum was always supplied to the under surface of the steel sheet 10. As a result, efficient cooling could be performed, and the cooling speed resulting from combination of the cooling at the under surface and the cooling at the top surface was increased to 30°C/s. In addition, since the cooling water was always supplied in the same state from the passage of the leading end to the passage of the tail end of the steel sheet, the strip temperature deviation in the longitudinal direction was reduced to 10°C.

[0043] Accordingly, the strip temperature deviations in the longitudinal direction and the widthwise direction of the steel plate or sheet could be reduced to a very small value. Therefore, the deviation of mechanical properties, such as tensile strength, could be reduced (difference between maximum strength and minimum strength: 1 kgf/mm^2 or less), so that the steel plate or sheet having high quality could be produced.

Claims

1. Line for hot rolling a steel plate or sheet (10), the line comprising a table roll (14) and a cooling equipment (20, 30), the cooling equipment (20, 30) comprising:

   a plurality of protector plates (34) disposed below the steel plate or sheet (10) that is transfered, and obliquely with respect to a direction of transferring of the steel plate or sheet (10); and
   nozzle trains (32) provided between the protector plates (34) and obliquely with respect to the direction of transferring of the steel plate or sheet (10), for supplying cooling water to the under surface of the steel plate or sheet (10),
   wherein the nozzle trains (32) have the same number of tube-shaped nozzles disposed, respectively, on virtual lines (36) drawn at certain pitches in a steel plate or sheet (10) width direction of the steel plate or sheet (10),
   wherein the top ends of the tube-shaped nozzles are positioned below the top ends of the protector plates (34),
   characterised in that a header (31) to which the tube-shaped nozzles are mounted is positioned below a center of a circular cross section of the table roll (14),
   wherein the top end of each tube-shaped nozzle is positioned above the center of the circular cross section of the table roll (14) that transports the steel plate or sheet (10), and

wherein the tube-shaped nozzles are circular-tube-shaped nozzles, the inside diameter of the nozzles is 3 to 8 mm, and the jet speed is in use 1 to 10 m/s, and the nozzles supply rod-like water flow that is continuous and rectilinear and has a cross section that is maintained in a substantially circular form until the water flow collides with the steel plate or sheet (10).

2. The line for hot rolling a steel plate or sheet (10) according to claim 1, wherein the nozzle trains (32) are divided in two in the transferring direction, and a protector plate (35) is disposed between the divided rows in the steel plate or sheet (10) width direction.

3. A method of manufacturing a steel plate or sheet (10), which manufactures the steel plate or sheet (10) in a hot rolling line of the steel plate or sheet (10), the method comprising:

disposing a plurality of protector plates (34) below the steel plate or sheet (10) that is transfered, and obliquely with respect to a direction of transferring of the steel plate or sheet (10); and
providing nozzle trains (32) between the protector plates (34) and obliquely with respect to the direction of transferring of the steel plate or sheet (10), for supplying cooling water to the under surface of the steel plate or sheet (10),
wherein the nozzle trains (32) have the same number of tube-shaped nozzles disposed, respectively, on virtual lines (36) drawn at certain pitches in a plate or sheet (10) width direction of the steel plate or sheet (10),
wherein the top ends of the tube-shaped nozzles are positioned below the top ends of the protector plates (34),
characterised in that a header (31) to which the tube-shaped nozzles are mounted is positioned below a center of a circular cross section of the table roll (14),
wherein the top end of each tube-shaped nozzle is positioned above the center of the circular cross section of the table roll (14) that transfers the steel plate or sheet (10), and
wherein the tube-shaped nozzles are circular-tube-shaped nozzles, the inside diameter of the nozzles is 3 to 8 mm, the jet speed is 1 to 10 m/s, and the nozzles supply rod-like water flow that is continuous and rectilinear and has a cross section that is maintained in a substantially circular form until the water flow collides with the steel plate or sheet (10).

4. The method of manufacturing a steel plate or sheet (10) according to Claim 3, wherein the nozzle trains (32) are divided in two in the transferring direction, and a protector plate (35) is disposed between the divided rows in the steel plate or sheet (10) width direction.

Patentansprüche

1. Linie zum Warmwalzen einer Stahlplatte oder -blechs (10), die Linie mit einer Gangrolle (14) und einer Kühleinrichtung (20,30), die Kühleinrichtung (20,30) mit:

mehreren Schutzplatten (34), die unterhalb der Stahlplatte oder des -blechs (10), die/das verfahren wird, und schräg bezüglich einer Verfahrrichtung der Stahlplatte oder des -blechs (10) vorgesehen sind, und
Düsenanordnungen (32), die zwischen den Schutzplatten (34) und schräg bezüglich der Verfahrrichtung der Stahlplatte oder des -blechs (10) vorgesehen sind, um Kühlwasser zu der unteren Oberfläche der Stahlplatte oder des -blechs (10) zuzuführen,
wobei die Düsenanordnungen (32) die gleiche Anzahl an röhrenförmigen Düsen jeweils auf virtuellen Linien (36) vorgesehen hat, die mit bestimmten Abständen in einer Stahplatten oder -blech-Breitenrichtung der Stahlplatte oder des Blechs (10) gezogen sind,
wobei die oberen Enden der röhrenförmigen Düsen unterhalb der oberen Enden der Schutzplatten (34) vorgesehen sind,
dadurch kennzeichnet, dass ein Kopfteil (31), an dem die röhrenförmigen Düsen vorgesehen sind, unterhalb einer Mitte eines kreisförmigen Querschnitts der Gangrolle (14) positioniert ist,
wobei das obere Ende jeder röhrenförmigen Düse unterhalb der Mitte des kreisförmigen Querschnitts der Gangrolle (14) ist, welche die Stahlplatte oder das -blech (10) transportiert, und
wobei die röhrenförmigen Düsen kreisförmig röhrenförmige Düsen sind, der Innendurchmesser der Düsen 3 bis 8 mm ist und bei Verwendung die Strahlgeschwindigkeit 1 bis 10 m/s ist und die Düsen einen stabähnlichen Wasserfluss zuführen, der kontinuierlich und geradlinig ist und der einen Querschnitt hat, der in einer im Wesentlichen kreisförmigen Gestalt beibehalten wird, bis der Wasserfluss auf die Stahlplatte oder das -blech (10) auftrifft.

2. Linie zum Warmwalzen einer Stahlplatte oder eines -blechs (10) nach Anspruch 1, bei der die Düsenanordnungen (32) in zwei Teile in der Verfahrrichtung aufgeteilt sind und eine Schutzplatte (35) zwischen den geteilten Reihen in der Breitenrichtung der Stahlplatte oder des -blechs vorgesehen ist.

3. Verfahren zum Herstellen einer Stahlplatte oder eines - blechs (10), welches die Stahlplatte oder das -blech (10) in einer Warmwalzlinie der Stahlplatte oder des -blechs (10) herstellt, das Verfahren mit:

dem Vorsehen mehrerer Schutzplatten (34) unterhalb der Stahlplatte oder des -blechs (10), die/das verfahren wird, und schräg bezüglich einer Verfahrrichtung der Stahlplatte oder des -blechs (10), und
dem Bereitstellen von Düsenanordnungen (32) zwischen den Schutzplatten (34) und schräg bezüglich einer Verfahrrichtung der Stahlplatte oder des -blechs (10), zum Zuführen von Kühlwasser zur unteren Oberfläche der Stahlplatte oder des - blechs (10),
wobei die Düsenanordnungen (32) die gleiche Anzahl an röhrenförmigen Düsen jeweils auf virtuellen Linien (36) vorgesehen haben, die mit bestimmten Abständen in einer Platten oder Blech (10)-Breitenrichtung der Stahlplatte oder des -blechs (10) gezogen sind,
wobei die oberen Enden der röhrenförmigen Düsen unterhalb der oberen Enden der Schutzplatten (34) positioniert sind,
dadurch gekennzeichnet, dass ein Kopfteil (31), an dem die röhrenförmigen Düsen angebracht sind, unterhalb einer Mitte eines kreisförmigen Querschnitts der Gangrolle (40) positioniert ist,
wobei das obere Ende jeder röhrenförmigen Düse oberhalb der Mitte des kreisförmigen Querschnitts der Gangrolle (14) positioniert ist, welche die Stahlplatte oder das -blech (10) verfährt, und
wobei die röhrenförmigen Düsen kreisförmig röhrenförmige Düsen sind, die Innendurchmesser der Düsen 3 bis 8 mm sind, die Strahlgeschwindigkeit 1 bis 10 m/s ist und die Düsen einen stabähnlichen Wasserfluss zuführen, der kontinuierlich und geradlinig ist und einen Querschnitt hat, der in einer im wesentlichen kreisförmigen Gestalt beibehalten wird, bis der Wasserfluss auf die Stahlplatte oder das -blech (10) auftrifft.

4. Verfahren zum Herstellen einer Stahlplatte oder eines - blechs (10) nach Anspruch 3, bei dem die Düsenanordnungen (32) in zwei Teile in der Verfahrrichtung aufgeteilt sind und eine Schutzplatte (35) zwischen den aufgeteilten Reihen in der Stahlplatten oder -blech-(10)-Breitenrichtung vorgesehen ist.

Revendications

1. Ligne pour laminage à chaud d'une plaque ou tôle d'acier (10), la ligne comprenant un rouleau de tablier (14) et un équipement de refroidissement (20, 30), l'équipement de refroidissement (20, 30) comprenant :

une pluralité de plaques protectrices (34) disposées au-dessous de la plaque ou tôle d'acier (10) qui est transférée, et de façon oblique par rapport à une direction de transfert de la plaque ou tôle d'acier (10) ; et
des trains de buses (32) disposés entre les plaques protectrices (34) et de façon oblique par rapport à la direction de transfert de la plaque ou tôle d'acier (10) pour fournir de l'eau de refroidissement à la surface de dessous de la plaque ou tôle d'acier (10),
dans laquelle les trains de buses (32) ont le même nombre de buses en forme de tube respectivement disposées sur des lignes virtuelles (36) tracées à certains intervalles dans une direction de largeur de plaque ou tôle d'acier (10) de la plaque ou tôle d'acier (10),
dans laquelle les extrémités supérieures des buses en forme de tube sont positionnées au-dessous des extrémités supérieures des plaques protectrices (34),
caractérisée en ce qu'une embase (31) sur laquelle les buses en forme de tube sont montées est positionnée au-dessous d'un centre d'une section transversale circulaire du rouleau de tablier (14),
dans laquelle l'extrémité supérieure de chaque buse en forme de tube est positionnée au-dessus du centre de la section transversale circulaire du rouleau de tablier (14) qui transporte la plaque ou tôle d'acier (10), et
dans laquelle les buses en forme de tube sont des buses en forme de tube circulaire, le diamètre intérieur des buses est de 3 à 8 mm, et la vitesse de jet est en fonctionnement de 1 à 10 m/s ; et les buses fournissent du flux d'eau semblable à une tige qui est continu et rectiligne et a une section transversale qui est maintenue dans une forme substantiellement circulaire jusqu'à ce que le flux d'eau entre en collision avec la plaque ou tôle d'acier (10).

2. Ligne pour laminage à chaud d'une plaque ou tôle d'acier (10) selon la revendication 1, dans laquelle les trains de buses (32) sont divisés en deux dans la direction de transfert, et une plaque protectrice (35) est disposée entre les rangées divisées dans la direction de largeur de plaque ou tôle d'acier (10).

3. Procédé de fabrication d'une plaque ou tôle d'acier (10) qui fabrique la plaque ou tôle d'acier (10) sur une ligne de laminage à chaud de la plaque ou tôle d'acier (10), le procédé comprenant les étapes qui consistent à :

disposer une pluralité de plaques protectrices (34) au-dessous de la plaque ou tôle d'acier (10) qui est transférée, et de façon oblique par rapport à une direction de transfert de la plaque ou tôle d'acier (10) ; et
fournir des trains de buses (32) entre les plaques protectrices (34) et de façon oblique par rapport à la direction de transfert de la plaque ou tôle d'acier (10), pour fournir de l'eau de refroidissement à la surface de dessous de la plaque ou tôle d'acier (10) ;
dans lequel les trains de buses (32) ont le même nombre de buses en forme de tube respectivement disposées sur des lignes virtuelles (36) tracées à certains intervalles dans une direction de largeur de plaque ou tôle (10) de la plaque ou tôle d'acier (10),
dans lequel les extrémités supérieures des buses en forme de tube sont positionnées au-dessous des extrémités supérieures des plaques protectrices (34),
caractérisé en ce qu'une embase (31) à laquelle les buses en forme de tube sont montées est positionnée au-dessous d'un centre d'une section transversale circulaire du rouleau de tablier (14),
dans lequel l'extrémité supérieure de chaque buse en forme de tube est positionnée au-dessus du centre de la section transversale circulaire du rouleau de tablier (14) qui transfère la plaque ou tôle d'acier (10), et
dans lequel les buses en forme de tube sont des buses en forme de tube circulaire, le diamètre intérieur des buses est de 3 à 8 mm, la vitesse de jet est de 1 à 10 m/s, et les buses fournissent du flux d'eau semblable à une tige qui est continu et rectiligne et a une section transversale qui est maintenue dans une forme substantiellement circulaire jusqu'à ce que le flux d'eau entre en collision avec la plaque ou tôle d'acier (10).

4. Procédé de fabrication d'une plaque ou tôle d'acier (10) selon la revendication 3, dans lequel les trains de buse (32) sont divisés en deux dans la direction de transfert, et une plaque protectrice (35) est disposée entre les rangées divisées dans la direction de largeur de plaque ou tôle d'acier (10).

FIG.1

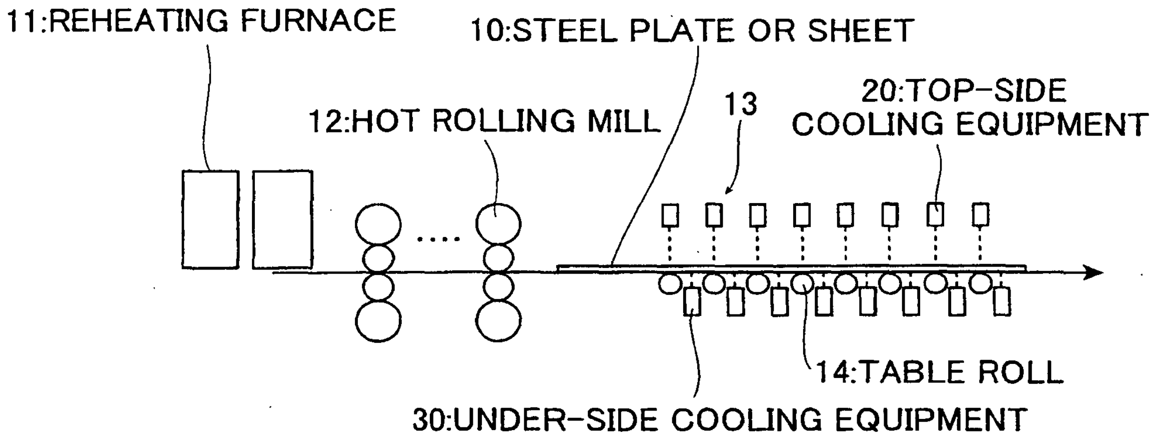

11:REHEATING FURNACE
10:STEEL PLATE OR SHEET
12:HOT ROLLING MILL
13
20:TOP-SIDE COOLING EQUIPMENT
14:TABLE ROLL
30:UNDER-SIDE COOLING EQUIPMENT

FIG.2

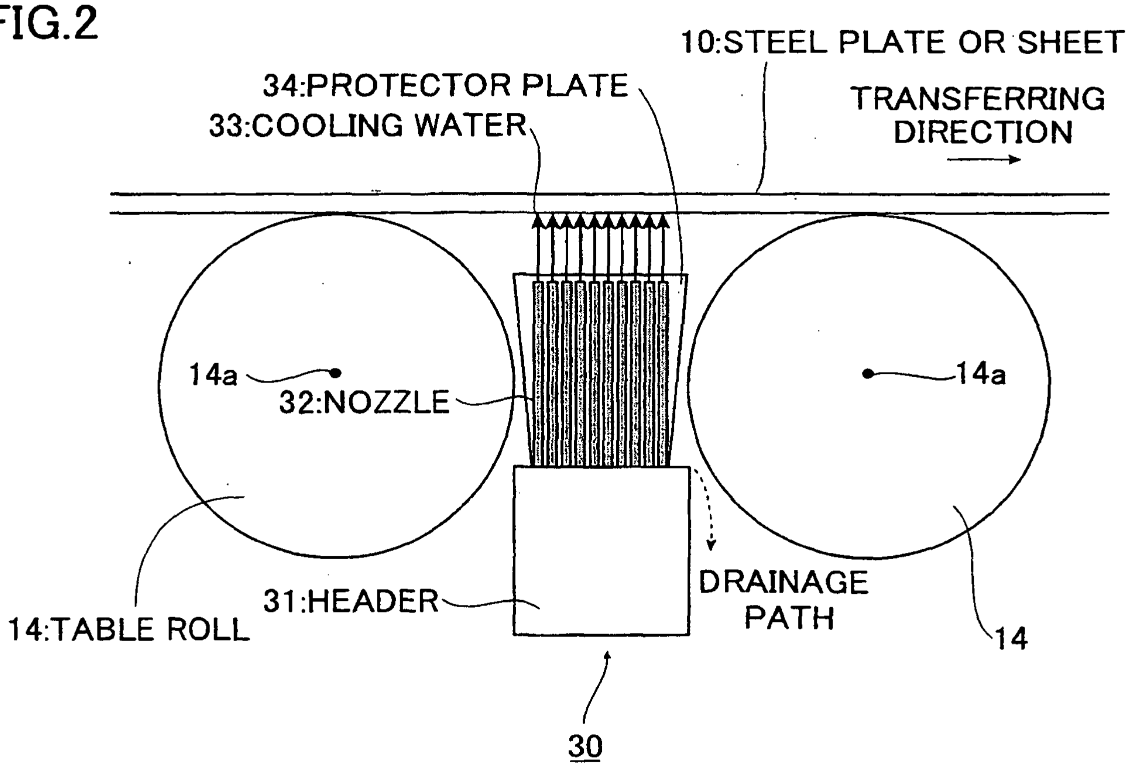

10:STEEL PLATE OR SHEET
34:PROTECTOR PLATE
33:COOLING WATER
TRANSFERRING DIRECTION
14a
32:NOZZLE
14a
DRAINAGE PATH
31:HEADER
14:TABLE ROLL
14
30

FIG.3

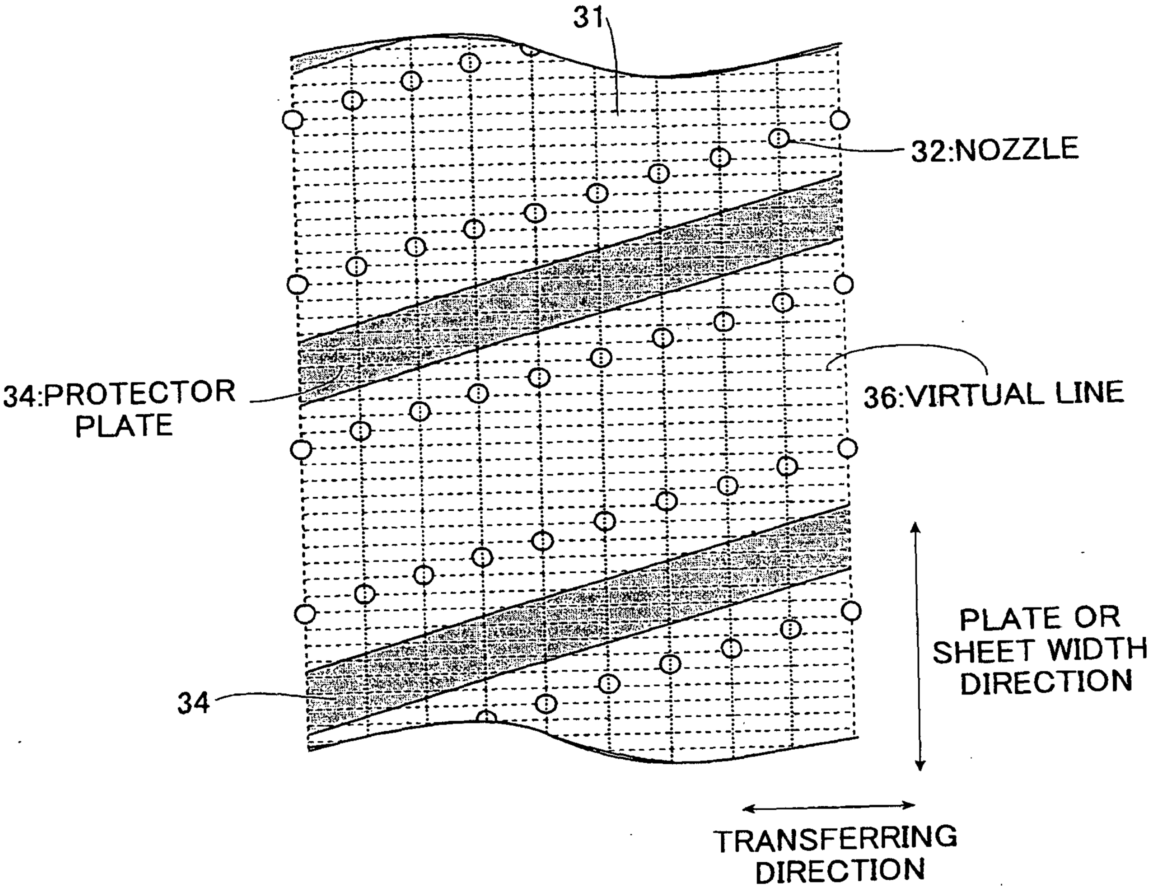

31
32:NOZZLE
34:PROTECTOR PLATE
36:VIRTUAL LINE
34
PLATE OR SHEET WIDTH DIRECTION
TRANSFERRING DIRECTION

FIG.4

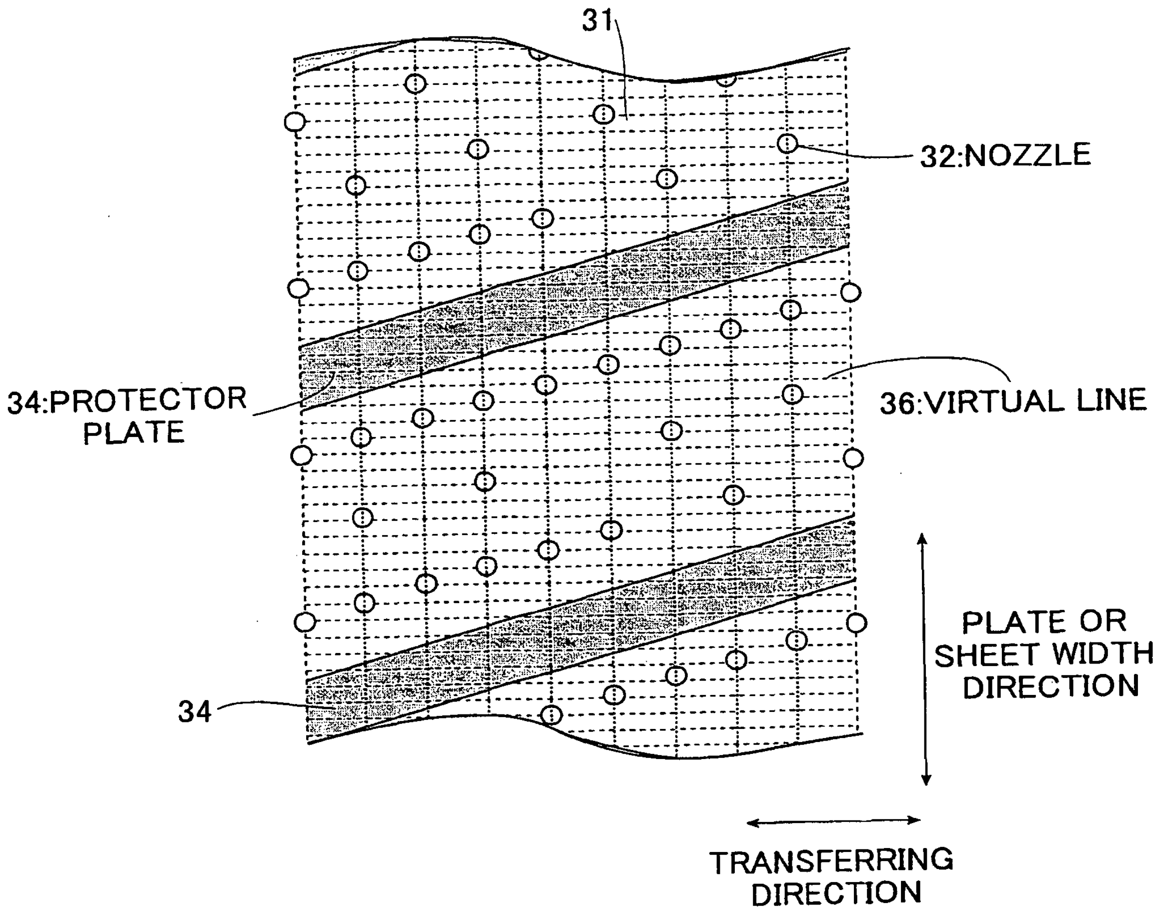

31
32:NOZZLE
34:PROTECTOR PLATE
36:VIRTUAL LINE
34
PLATE OR SHEET WIDTH DIRECTION
TRANSFERRING DIRECTION

FIG.5

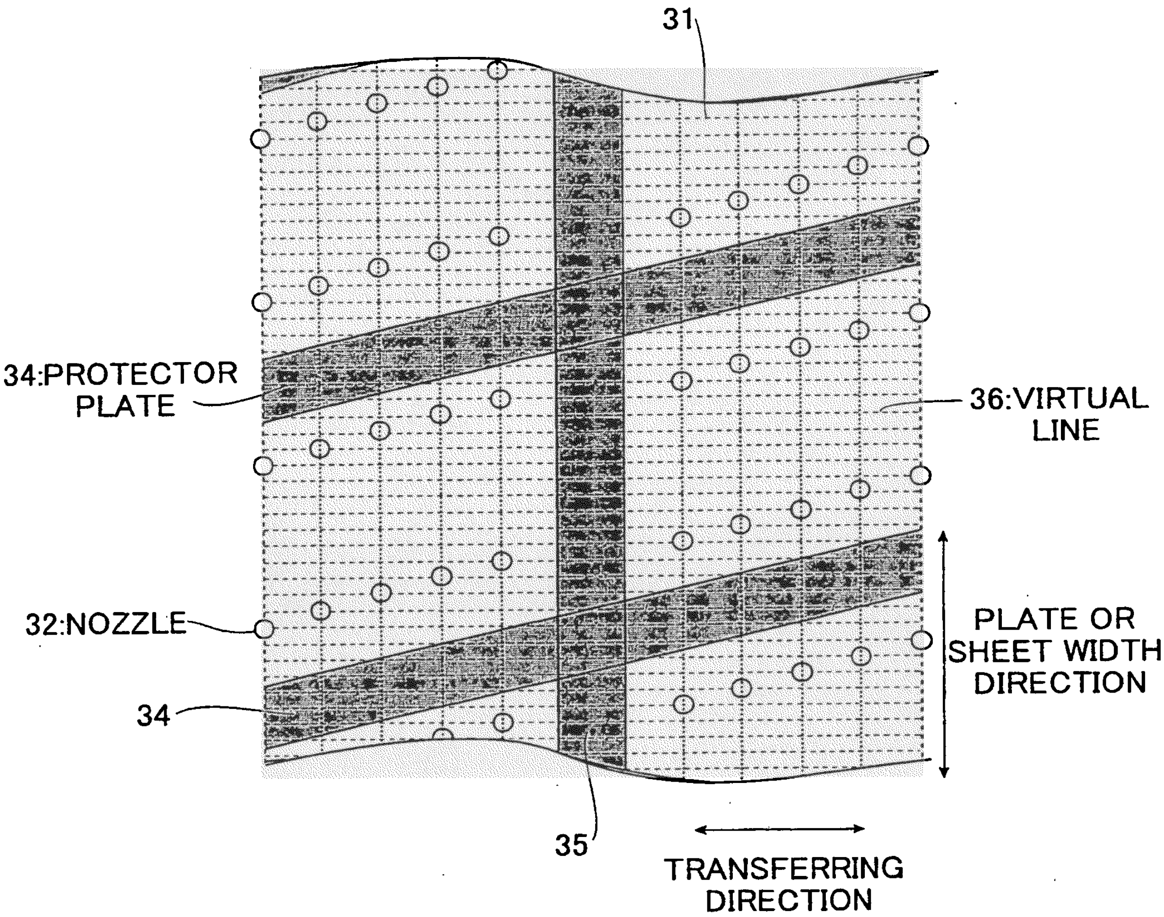

31
34:PROTECTOR PLATE
36:VIRTUAL LINE
32:NOZZLE
34
PLATE OR SHEET WIDTH DIRECTION
35
TRANSFERRING DIRECTION

FIG.6

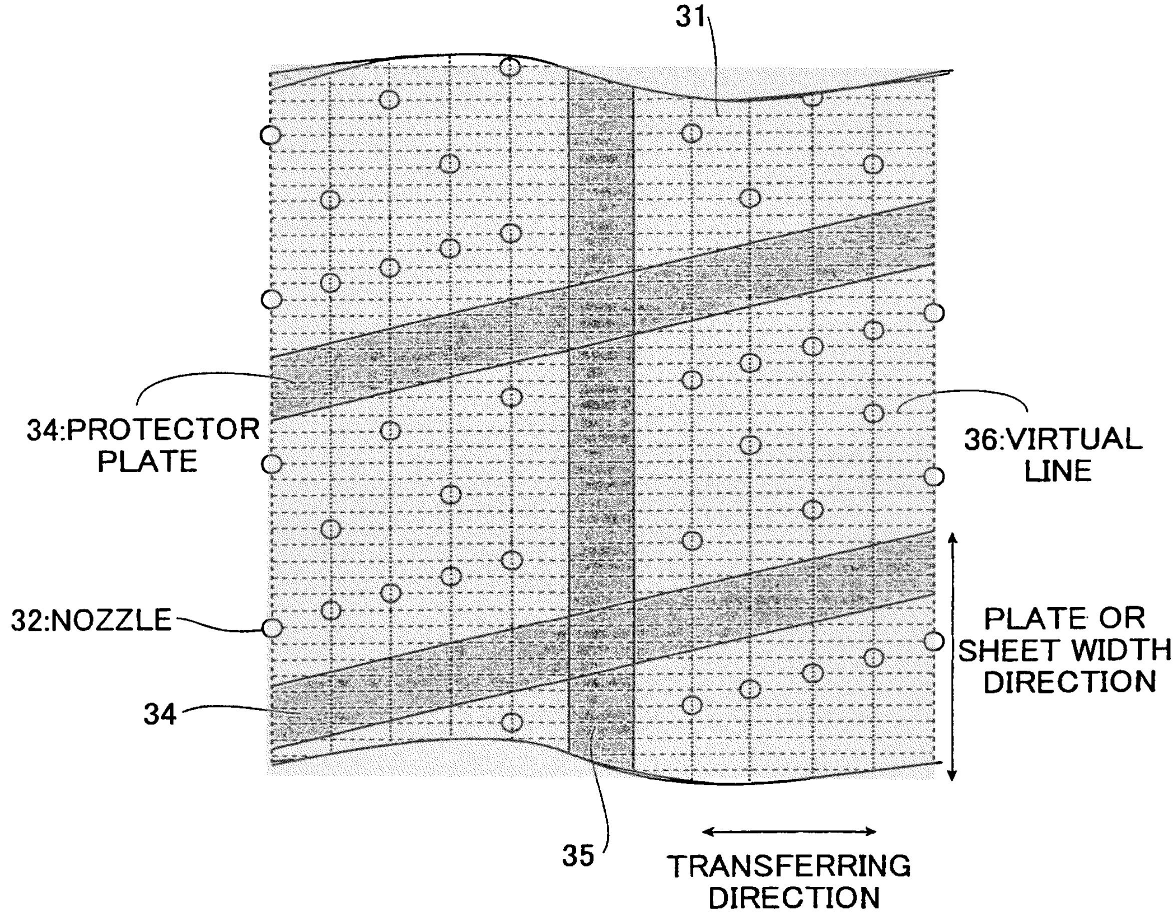
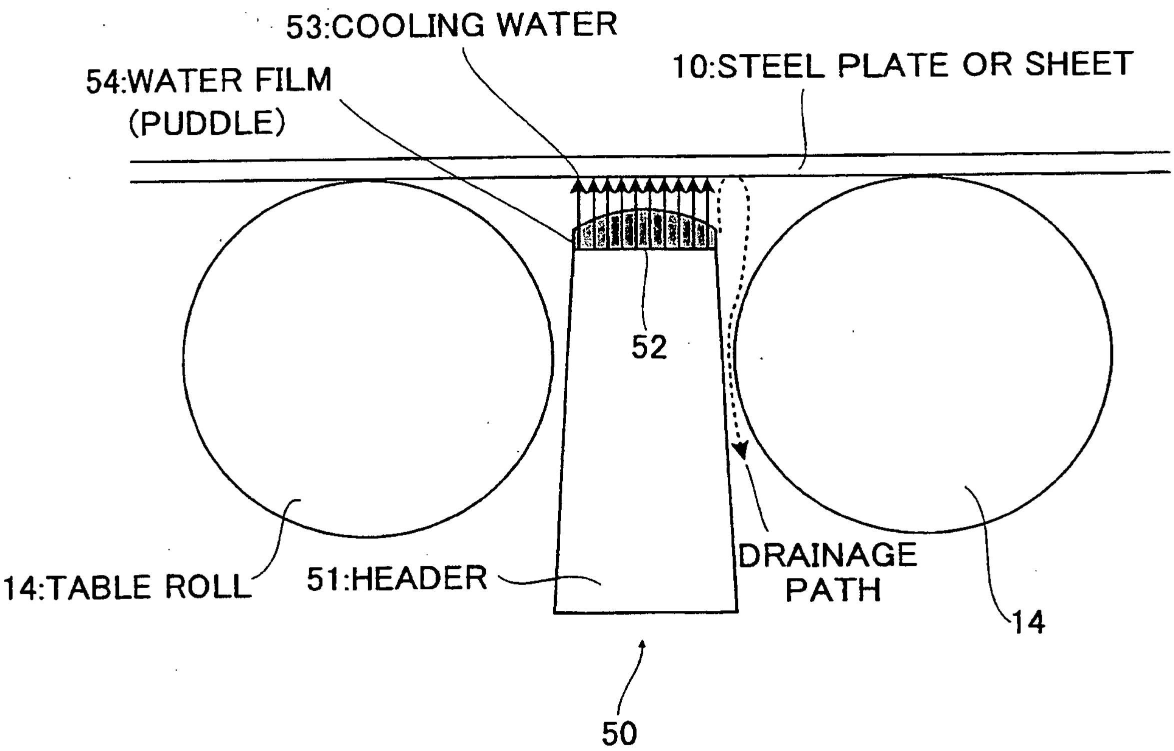

31
34:PROTECTOR PLATE
36:VIRTUAL LINE
32:NOZZLE
34
PLATE OR SHEET WIDTH DIRECTION
35
TRANSFERRING DIRECTION

FIG.7


53:COOLING WATER
54:WATER FILM
(PUDDLE)
10:STEEL PLATE OR SHEET
52
DRAINAGE
PATH
14:TABLE ROLL
51:HEADER
14
50

REFERENCES CITED IN THE DESCRIPTION

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- JP 62259610 A **[0003] [0005] [0006] [0034]**
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- JP 601664413 U **[0011]**
- EP 1527829 A1 **[0011]**