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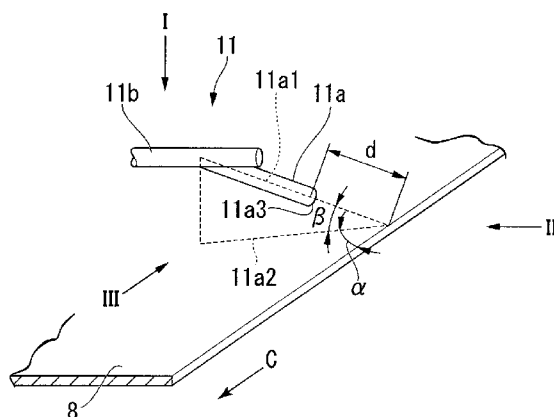
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(54) Title: DEVICE FOR PRODUCING COATED STEEL SHEET AND METHOD FOR PRODUCING COATED STEEL SHEET

(54) 発明の名称: 塗装鋼板の製造装置及び塗装鋼板の製造方法

[図3A]



(57) Abstract: This device for producing a coated steel sheet is provided with: blow-off unit (11) that blows gas against excess coat-
ing material (9x) accumulated along the edge of a steel sheet (8) passing along in one direction, thus eliminating the excess coating
material; and a coating material recovery unit (12) that recovers the excess coating material (9x) eliminated by the blow-off unit (11).
The blow-off unit (11) has a blowing nozzle (11a) and a gas supply unit (11c). The coating material recovery unit (12) has a duct
(12a) and a coating material housing vessel (12b). When viewing the duct (12a) in a plan view, the exit (12a2) thereof is disposed
overlapping in a manner so as to fall within the opening (12b1) of the coating material housing vessel (12b), and moreover, when
viewing the duct (12a) in a lateral view, a gap (12c) is provided between the opening (12b1) of the coating material housing vessel
(12b) and the exit (12a2).

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— 国際調査報告 (条約第 21 条(3))

塗装鋼板の製造装置であって、一方向に沿って通板する鋼板（８）の側縁に沿って蓄積する余剰塗料（９ x）に気体を吹き付けて除去する吹き飛ばし部（１１）と、この吹き飛ばし部（１１）により除去された前記余剰塗料（９ x）を回収する塗料回収部（１２）とを備え、前記吹き飛ばし部（１１）が、吹付けノズル（１１ a）と、気体供給部（１１ c）とを有し；前記塗料回収部（１２）が、ダクト（１２ a）と、塗料収容器（１２ b）と、を有し；前記ダクト（１２ a）を平面視した場合に、その出口（１２ a ２）が前記塗料収容器（１２ b）の開口（１２ b １）内に収まるように重なって配置され、なおかつ、前記ダクト（１２ a）を側面視した場合に、その前記出口（１２ a ２）と前記塗料収容器（１２ b）の前記開口（１２ b １）との間に隙間（１２ c）が設けられている。

[Document Type] Specification

[Title of the Invention] DEVICE FOR PRODUCING COATED STEEL SHEET
AND METHOD FOR PRODUCING COATED STEEL SHEET

[Technical Field of the Invention]

[0001]

The present invention relates to a device for producing a coated steel sheet and a method for producing a coated steel sheet capable of reliably solving a problem caused by excessive coating which accumulates along a side edge of a steel sheet.

[Related Art]

[0002]

Recently, due to the expansion of usages, a coated steel sheet has been required to have further improvements in quality and characteristics, for example, a uniform thickness of a coating film, improvements in surface glossiness and surface smoothness, stacking and compounding of coating films, and thinning and thickening of coating films.

[0003]

For example, in Patent Document 1, for the purpose of rectifying air current in the atmosphere, a technique of discharging gas into the atmosphere to prevent coating that falls in a curtain shape from shaking and uniformize the film thickness of a coating film is disclosed. In Patent Document 2, a technique of discharging gas into an object to be coated so as to remove a thick coating generated immediately after starting the application of the coating and achieve a uniform thickness overall is disclosed.

[0004]

However, it is apparent from the technical configuration that the technique disclosed in Patent Document 1 has an effect only in a case where the falling coating

has a small flow rate and a low flow velocity, or the falling coating has a low viscosity. In addition, in Patent Document 2, as described in the examples thereof, only a case where the discharge flow rate of gas is a small flow rate of about 10 m³/h and a low-viscosity coating having a viscosity of 10 cP (centipoise) is used is postulated. These techniques cannot cope with the thickening of a coating film using a high-viscosity coating and the like among the above-mentioned characteristics that require further improvements.

[0005]

On the other hand, in Patent Documents 3 to 9, techniques of stacking and applying coatings using a multilayer curtain coater are disclosed. The multilayer curtain coater forms a multilayer coating film without contact, and thus has characteristics in that surface defects such as roping of a coating film, which occurs in a case of using a roll coater, do not occur.

[0006]

However, the stacking of coating films according to a wet-on-wet method including the multilayer curtain coater and the roll coater has a problem in that coatings are mixed with each other and locally form a mixed layer and thus external appearance failure such as stripe patterns is likely to occur. That is, although the techniques in the related art cope with the stacking of coating films among the above-mentioned characteristics that require further improvements, there are still problems.

[Prior Art Document]

[Patent Document]

[0007]

[Patent Document 1] Japanese Unexamined Patent Application, First Publication No. 2004-181451

[Patent Document 2] Japanese Unexamined Patent Application, First
Publication No. 2002-273299

[Patent Document 3] Japanese Unexamined Patent Application, First
Publication No. H07-080378

[Patent Document 4] Japanese Unexamined Patent Application, First
Publication No. H07-080394

[Patent Document 5] Japanese Unexamined Patent Application, First
Publication No. H07-080395

[Patent Document 6] Japanese Unexamined Patent Application, First
Publication No. H07-080396

[Patent Document 7] Japanese Unexamined Patent Application, First
Publication No. H08-252502

[Patent Document 8] Japanese Unexamined Patent Application, First
Publication No. H08-276150

[Patent Document 9] Japanese Unexamined Patent Application, First
Publication No. 2006-175826

[Summary of the Invention]

[Problems to be Solved by the Invention]

[0008]

The present inventors have paid attention to a possibility that the above problems may be solved by using a high-viscosity coating having a viscosity of 700 mPa·sec (700 cP) or higher and 2000 mPa·sec (2000 cP) or lower. That is, by using the high-viscosity coating, the thickening of a coating film can be achieved to a higher degree than that of the related art, and even in a case where the coating films are stacked by the wet-on-wet method, the coatings can be prevented from being mixed

with each other and thus the stacking of the coating films can be achieved.

[0009]

The present inventors performed various experiments by using the high-viscosity coating, and as a result, it was confirmed that the above-described effects can be obtained. However, when the high-viscosity coating was used, it became apparent that there is a problem in that after applying a coating to a steel sheet, a coating film protrusion in which excessive coating accumulates is formed at side edge of the steel sheet in the sheet-width direction (which are the ends of the steel sheet in the sheet-width direction and are parts of the steel sheet along the longitudinal direction).

[0010]

FIG. 6 is a perspective view illustrating a device for producing a coated steel sheet, which coats a steel sheet using a coating curtain, according to the related art. As illustrated in FIG. 6, a coating 3 which stays between an applicator roll 1 that rotates in an arrow A direction and a doctor roll 2 that rotates in an arrow B direction is scraped by a blade 4 and forms a coating curtain 3a. A pair of curtain guides 5 is provided so that the coating curtain 3a reaches a coating pan 6 from the blade 4 without contracted flow, and thus the curtain thickness of the coating curtain 3a in the sheet-width direction becomes uniform. The coating curtain 3a falls onto the surface of a steel sheet 8 which is supported by a support roll 7 and threads in an arrow C direction such that a coating film 9 is formed on the steel sheet 8. In addition, the coating pan 6 which is provided below the steel sheet 8 accommodates the coating 3 which is not used for coating the steel sheet 8.

[0011]

FIG. 7 is a longitudinal sectional view of the steel sheet 8 after the coating film 9 is formed, and is a cross-sectional view taken along the line X-X of FIG. 6. In

a case where the coating 3 is a high-viscosity coating having a viscosity of 700 mPa·sec (700 cP) or higher and 2000 mPa·sec (2000 cP) or lower, as illustrated in FIG. 7, the excessive coating 3 accumulates at both side edge 8x of the steel sheet 8 in the sheet-width direction (which are ends of the steel sheet 8 in the sheet-width direction and are parts of the steel sheet 8 along the longitudinal direction) such that coating film protrusion 9x in which the coating film 9 protrudes are formed.

[0012]

When the coating film protrusion 9x is formed on the coated steel sheet, there may be cases where the coated steel sheet cannot be cleanly coiled in a production process and thus production efficiency is reduced. In addition, when the coating film protrusion 9x is formed, there may be cases where the product shipping form of the coated steel sheet such as lot size or shape is also limited.

[0013]

In order to solve the problems, the coating film protrusion 9x needs to be removed. The present inventors examined various methods of removing the coating film protrusion 9x, and as a result, it was proved that a method of blowing off and removing the coating film protrusion 9x by spraying gas is preferable from the viewpoints of product quality, production cost, maintenance of a production device, and the like.

[0014]

However, when the excessive coating (the coating film protrusion 9x) which accumulates on the steel sheet 8 is blown off by the blowing-off method, there is concern that the blown-off coating may scatter and adhere to the steel sheet 8 again. That is, when the blown-off coating is reflected or flows back and adheres to the steel sheet 8 again, there may be cases where external appearance failure on the coated steel

sheet which is a product occurs.

[0015]

That is, although there is a possibility that the above-described problems associated with the thickening of the coating film 9 or the stacking of the coating film 9 may be solved by using the high-viscosity coating 3, there is concern that the coating film protrusion 9x may be formed along the side edge 8x of the steel sheet 8.

Although the blowing-off method performed by spraying gas is preferable as the method of removing the coating film protrusion 9x, there is concern that a problem in that the blown-off coating returns and adheres to the steel sheet 8 again may newly occur. In order to cope with this, using an aspirator including a fan for gas discharge may be considered. However, the suctioned excessive coating adheres to the fan and thus maintenance is necessary, resulting in a reduction in production efficiency. From this viewpoint, it is difficult to adopt this technique.

For the above-described reasons, in the related art, solving the various problems due to the excessive coating (coating film protrusion 9x) that adheres to the side edge 8x of the steel sheet 8 causes another problem in turn, and thus it is difficult to collectively solve all the problems.

[0016]

The present invention has been made taking the foregoing circumstances into consideration, and an object thereof is to provide a device for producing a coated steel sheet and a method for producing a coated steel sheet capable of removing excessive coating that accumulates along the side edge of a steel sheet and reliably preventing the removed excessive coating from re-adhering to the steel sheet.

[Means for Solving the Problem]

[0017]

The gist of the present invention is as follows.

[0018]

(1) A device for producing a coated steel sheet according to an aspect of the present invention includes: a blowing-off unit which sprays a gas onto and remove an excessive coating that accumulates along a side edge of a steel sheet that threads along one direction; and a coating-collection unit which collects the excessive coating removed by the blowing-off unit. The blowing-off unit includes a spray nozzle which is directed in a direction from an inside to an outside in a sheet-width direction of the steel sheet and directed toward the side edge, and a gas supply member which supplies the gas to the spray nozzle. The coating-collection unit includes a duct having an inlet that receives the excessive coating and an outlet that discharges the received excessive coating, and a coating container having an opening that receives the excessive coating discharged from the outlet. In a case where the duct is seen in a plan view, the outlet is disposed to fit in and overlap an inside of the opening of the coating container, and in a case where the duct is seen in a side view, a gap is provided between the outlet and the opening of the coating container.

(2) In the producing device described in (1), when an angle between an extension line of a center axis line of the spray nozzle and a projection line of the extension line on a surface of the steel sheet is defined as β , an angle between the projection line and a sheet threading direction of the steel sheet in a case where the surface is seen in a facing view is defined as α , and the distance from a tip end of the spray nozzle to a point that intersects a plane including the surface when seen along the extension line is defined as d in units of mm, all the following Expressions A, B, and C may be satisfied, and a discharge direction of the spray nozzle may be disposed to be opposite to the sheet threading direction of the steel sheet.

$20^{\circ} \leq \alpha \leq 70^{\circ}$... (Expression A)

$20^{\circ} \leq \beta \leq 70^{\circ}$... (Expression B)

$10 \text{ mm} \leq d \leq 55 \text{ mm}$... (Expression C)

(3) In the producing device described in (1) or (2), a size of the gap in a side view may be 60 mm or more and 100 mm or less.

(4) In the producing device described in any one of (1) to (3), a viscosity of the coating applied to the steel sheet may be 700 mPa·sec or higher and 2000 mPa·sec or lower.

(5) In the producing device described in any one of (1) to (4), the blowing-off unit may be adjusted so that a discharge flow rate of the gas discharged from the spray nozzle is 12 m³/h or more and 20 m³/h or less, a discharge flow velocity of the gas discharged from the spray nozzle at a position of 5 mm from a tip end of the spray nozzle in a discharge direction when seen along an extension line of a center axis line of the spray nozzle is 420 m/s or more and 520 m/s or less, and a discharge flow velocity of the gas discharged from the spray nozzle at a position of 5 mm from a point where the extension line intersects a plane including a surface of the steel sheet toward the spray nozzle when seen along the extension line of the center axis line of the spray nozzle is 130 m/s or more and 520 m/s or less.

(6) In the producing device described in any one of (1) to (5), the inlet of the duct may be provided with an extension member which receives the excessive coating directed to an outside of the inlet.

(7) In the producing device described in any one of (2) to (6), the spray nozzle may be disposed so that the discharge direction of the gas is along with the sheet threading direction when seen in the plan view.

(8) In the producing device described in any one of (2) to (7), the spray nozzle

may be disposed to further satisfy the following Expression D.

$$0.1 \leq \sin \alpha \cdot \cos \beta \leq 0.9 \quad \dots (\text{Expression D})$$

(9) In the producing device described in any one of (1) to (8), a shape of a discharge port of the spray nozzle in a facing view may be any of a rectangle, a circle, an ellipse, and a flat shape.

(10) A method for producing a coated steel sheet according to another aspect of the present invention includes: blowing off and removing excessive coating that accumulates along a side edge of a steel sheet on which a coating is applied; and receiving and collecting the removed excessive coating by a coating container via a duct having an inlet and an outlet. An internal pressure of the duct is released from a gap between the outlet of the duct and an opening of the coating container.

(11) In the producing method described in (10), a viscosity of the coating applied to the steel sheet may be 700 mPa·sec or higher and 2000 mPa·sec or lower.

[Effects of the Invention]

[0019]

According to the aspects of the present invention, the excessive coating that accumulates along the side edge of the steel sheet is blown off and removed, the blown-off coating is prevented from being reflected or flowing back and re-adhering to the steel sheet and the blown-off coating can be reliably collected.

As a result, without a reduction in production efficiency or a limitation to the product shipping form, external appearance failure of the coated steel sheet does not occur. Therefore, it is possible to achieve thickening of the coating film to a higher degree than that of the related art, stacking of coating films in which the generation of a mixed layer of coatings is suppressed, and the like.

[Brief Description of the Drawing]

[0020]

FIG. 1 is a perspective view illustrating a device for producing a coated steel sheet according to an embodiment of the present invention.

FIG. 2 is a diagram illustrating a coating-collection unit included in the device for producing a coated steel sheet, and is a side view seen in an arrow Y direction of FIG. 1.

FIG. 3A is a perspective view illustrating the arrangement of a spray nozzle of a blowing-off unit included in the device for producing a coated steel sheet.

FIG. 3B is a plan view of FIG. 3A seen in an arrow I direction.

FIG. 3C is a side view of FIG. 3A seen in an arrow II direction.

FIG. 3D is a front view of FIG. 3A seen in an arrow III direction.

FIG. 4 is a diagram illustrating a modified example in which an extension member is provided in an inlet of a duct of the coating-collection unit and is a side view corresponding to FIG. 2.

FIG. 5 is a diagram illustrating Example 1 shown in Table 1 and is a photograph of the side edge part of a steel sheet when viewed in a cross section perpendicular to a sheet threading direction thereof.

FIG. 6 is a perspective view illustrating a device for producing a coated steel sheet, which coats a steel sheet using a coating curtain, according to the related art.

FIG. 7 is a diagram illustrating the steel sheet after a coating film is formed when viewed in a cross section perpendicular to the sheet threading direction thereof, and is a cross-sectional view taken along the line X-X of FIG. 6.

[Embodiments of the Invention]

[0021]

A device for producing a coated steel sheet according to an embodiment of the

present invention will be described in detail with reference to the drawings. However, the present invention is not limited only to the configuration of the following embodiment, and can be modified in various forms within a range that does not depart from the gist of the present invention. In addition, in the drawings used in the following description, there may be cases where parts which are the main parts are enlarged for convenience to facilitate an understanding of the features of the present invention and the ratio of the dimensions and the like of each constituent element are not limited to be the same as those in practice.

[0022]

FIG. 1 is a perspective view illustrating the device for producing a coated steel sheet according to this embodiment. As illustrated in FIG. 1, a coating 3 which stays between an applicator roll 1 that rotates in an arrow A direction and a doctor roll 2 that rotates in an arrow B direction is scraped by a blade 4 and forms a coating curtain 3a. A pair of curtain guides 5 is provided so that the coating curtain 3a reaches a coating pan 6 from the blade 4 without contracted flow, and thus the curtain thickness of the coating curtain 3a in the width direction becomes uniform. The coating curtain 3a falls onto the surface of a steel sheet 8 which threads in an arrow C direction such that a coating film 9 is formed on the steel sheet 8. In addition, the coating pan 6 which is provided below the steel sheet 8 accommodates the coating 3 which is not used for coating the steel sheet 8. In addition, the device for producing a coated steel sheet according to this embodiment includes a blowing-off unit 11 which sprays a gas onto and remove coating film protrusion 9x that excessively accumulates along both side edge 8x of the steel sheet 8 and a coating-collection unit 12 which collects the coating film protrusion 9x that is removed by the blowing-off unit 11.

[0023]

The blowing-off unit 11 includes spray nozzles 11a, a gas supply pipe 11b, and a gas supply member 11c. Compressed gas is supplied from the gas supply member 11c to the spray nozzle 11a through the gas supply pipe 11b. In addition, the compressed gas is discharged from the spray nozzles 11a which are arranged to be directed in directions from the inside to the outside in the sheet-width direction of the steel sheet 8 and in directions from above the steel sheet 8 toward the coating film protrusion 9x, thereby blowing off and removing the coating film protrusion 9x which is the excessive coating. As a result, in the device for producing a coated steel sheet according to this embodiment, winding of the coated steel sheet in a production process is not impeded, and the product shipping form of the coated steel sheet such as lot size or shape is also not limited.

[0024]

The coating-collection unit 12 includes a duct 12a and a coating container 12b. An inlet 12a1 of the duct 12a is disposed facing a discharge direction of the compressed gas of the spray nozzle 11a. In addition, the excessive coating blown off by the blowing-off unit 11 is taken in the inlet 12a1 of the duct 12a. The excessive coating taken in the duct 12a passes through the inside of the duct 12a and is discharged from an outlet 12a2 of the duct 12a.

[0025]

In the coating container 12b, when the duct 12a is seen in a plan view, the outlet 12a2 of the duct 12a is disposed to coaxially fit in and overlap the inside of an opening 12b1 of the coating container 12b. As such, it is preferable that the opening 12b1 has a larger opening area than the outlet 12a2. Accordingly, the taken excessive coating can be collected without leakage. FIG. 2 is a diagram illustrating the coating-collection unit 12 included in the device for producing a coated steel sheet, and is a

side view seen in an arrow Y direction of FIG. 1. As illustrated in FIG. 2, a gap 12c is provided along a vertical direction between the outlet 12a2 of the duct 12a and the opening 12b1 of the coating container 12b.

[0026]

In the duct 12a and the coating container 12b, the internal pressure thereof becomes higher than the atmospheric pressure due to the compressed gas discharged from the spray nozzle 11a. In this embodiment, the internal pressure is released from the gap 12c to the outside of the duct 12a, and thus an increase in the internal pressure of the duct 12a and the coating container 12b is prevented. Accordingly, an air current from the duct 12a to the coating container 12b and a flow of the excessive coating in the air current become smooth. As a result, the excessive coating taken in the duct 12a can be prevented from flowing back and re-adhering to the steel sheet 8. As such, in the device for producing a coated steel sheet according to this embodiment, gas discharge using an aspirator including a fan or the like, which needs maintenance and thus causes a reduction in production efficiency, is not necessary.

[0027]

In addition, in FIG. 1, as the device for producing a coated steel sheet according to this embodiment, the device for producing a coated steel sheet using the blade type curtain coater is exemplified. However, the present invention is not limited only to the device including the blade type curtain coater as long as the device includes the blowing-off unit 11 and the coating-collection unit 12, and for example, may also be applied to a device for producing a coated steel sheet which adopts a roll coater, a spray coater, a slide curtain coater, a coating method such as dip coating, or the like.

[0028]

Test 1: Spray-Smoothing Test

The present inventors performed a test for smoothing the coating film 9 (spray-smoothing test) by using the high-viscosity coating 3 having a viscosity of 700 mPa·sec or higher and 2000 mPa·sec or lower, changing the arrangement condition of the spray nozzle 11a in various manners, changing the conditions of the discharge flow velocity and the discharge flow rate of the gas discharged from the spray nozzle 11a in various manners, and blowing off the coating film protrusion 9x formed at the side edge 8x of the steel sheet 8. FIG. 3A is a diagram illustrating the arrangement of the spray nozzle 11a of the blowing-off unit 11 included in the device for producing a coated steel sheet, and is a perspective view seen in an arrow Z direction of FIG. 1. FIG. 3B is a plan view of FIG. 3A seen in an arrow I direction. FIG. 3C is a side view of FIG. 3A seen in an arrow II direction. FIG. 3D is a front view of FIG. 3A seen in an arrow III direction.

[0029]

As illustrated in FIGS. 3A to 3D, the angle between an extension line 11a1 of a center axis line of the spray nozzle 11a and a projection line 11a2 of the extension line 11a1 on the surface of the steel sheet 8 is referred to as β in units of degrees $^{\circ}$. In addition, in a case where the surface of the steel sheet 8 is seen in a facing view (as illustrated in FIG. 3B, in a case where FIG. 3A is seen in the plan view in the arrow I direction), the angle between the projection line 11a2 and a sheet threading direction C of the steel sheet 8 is referred to as α in units of degrees $^{\circ}$. Here, an angle α is the angle between the projection line 11a2 and the sheet threading direction C of the steel sheet 8 in a case where downstream in the sheet threading direction C is the reference (an angle of 0°). In addition, when seen along the extension line 11a1, the distance from a discharge port 11a3 which is the tip end of the spray nozzle to a point where the

extension line 11a1 intersects a plane including the surface of the steel sheet 8 is referred to as d in units of mm. By changing α , β , and d in various manners, the spray-smoothing test was performed. In addition, although not illustrated in FIGS. 3A to 3D, under any conditions, the coating-collection unit 12 was adjusted and arranged so that the inlet 12a1 of the duct 12a was facing the discharge direction of the compressed gas of the spray nozzle 11a.

[0030]

As a result of the test, the following knowledge was found. In a case where the angle α between the projection line 11a2 and the sheet threading direction C of the steel sheet 8, the angle β between the extension line 11a1 and the projection line 11a2, and the distance d from the discharge port 11a3 to the surface of the steel sheet 8 satisfy all the following Expressions A, B, and C, the coating film protrusion 9x which is the excessive coating on the steel sheet 8 can be appropriately blown off and removed.

$$20^{\circ} \leq \alpha \leq 70^{\circ} \quad \dots (\text{Expression A})$$

$$20^{\circ} \leq \beta \leq 70^{\circ} \quad \dots (\text{Expression B})$$

$$10 \text{ mm} \leq d \leq 55 \text{ mm} \quad \dots (\text{Expression C})$$

[0031]

In a case of $\alpha=90^{\circ}$, the gas is sprayed onto the side edge 8x of the steel sheet 8 at a right angle (with respect to the sheet threading direction C). In this case, the area of the steel sheet 8 that comes into contact with the gas is minimized, and the amount of the excessive coating being blown off is minimized, which is not preferable. For the same reason, when the angle α exceeds 70° , it is difficult to smooth the coating film 9 after the excessive coating is blown off. In addition, when the angle α is smaller than 20° , it is difficult to blow off the excessive coating, and there is a

possibility that the blown-off coating may re-adhere to the steel sheet 8. Therefore, it is preferable that the angle α is 20° to 70° . More preferably, the angle α is 30° to 60° .

[0032]

In FIGS. 3A to 3D, a case of $\alpha < 90^\circ$, that is, a case where the discharge direction of the spray nozzle 11a is substantially opposite to the sheet threading direction C of the steel sheet 8 is illustrated. However, the arrangement of the spray nozzle 11a is not limited to the above description, and even in a case of $\alpha > 90^\circ$, that is, even in a case where the spray nozzle 11a is arranged so that the discharge direction of the gas from the spray nozzle 11a is along with the sheet threading direction C when seen in the plan view, the obtained effect is substantially equal. In this case, it is preferable that the angle α satisfies 110° to 160° . More preferably, the angle α is 120° to 150° . In addition, as described above, the angle α is the angle between the projection line 11a2 and the sheet threading direction C of the steel sheet 8 in the case where downstream in the sheet threading direction C is the reference (an angle of 0°).

[0033]

Similarly, when the angle β is smaller than 20° , it is difficult to blow off the excessive coating. When the angle β exceeds 70° , it is difficult to smooth the coating film 9 after the excessive coating is blown off. Therefore, it is preferable that the angle β is 20° to 70° . More preferably, the angle β is 30° to 60° .

[0034]

When the distance d exceeds 55 mm, it is difficult to blow off the excessive coating. When the distance d is shorter than 10 mm, it is difficult to smooth the coating film 9 after the excessive coating is blown off. Therefore, it is preferable that the distance d is 10 mm to 55 mm. More preferably, the distance d is 15 mm to 40 mm.

[0035]

In addition, as a result of the test, the following knowledge was obtained.

When α , β , and d associated with the spray nozzle 11a satisfy all the above Expressions A, B, and C and also satisfy the following Expression D, the coating film protrusion 9x which is the excessive coating formed at the side edge 8x of the steel sheet 8 are reliably blown off and thus a flat coating film 9 can be obtained, which is more preferable.

$$0.1 \leq \sin \alpha \cdot \cos \beta \leq 0.9 \quad \dots (\text{Expression D})$$

[0036]

The above Expression D is an expression that shows a preferable arrangement of the spray nozzle 11a. The upper limit and the lower limit of the Expression D were set on the basis of the result of the spray-smoothing test. More preferably, $0.2 \leq \sin \alpha \cdot \cos \beta \leq 0.8$ is set. Most preferably, $0.4 \leq \sin \alpha \cdot \cos \beta \leq 0.6$ is set.

[0037]

In FIGS. 3A to 3D, an example in which the intersection between the extension line 11a1 of the center axis line of the spray nozzle 11a and the steel sheet 8 is on the side edge 8x of the steel sheet 8 is illustrated. However, the arrangement of the spray nozzle 11a is not limited thereto. As a result of the test, the following knowledge was obtained. It is preferable that the intersection between the extension line 11a1 of the center axis line of the spray nozzle 11a and the steel sheet 8 is in a range of 0 mm or more and 5 mm or less from the side edge 8x of the steel sheet 8 toward the inside in the sheet-width direction. When the intersection between the extension line 11a1 of the center axis line of the spray nozzle 11a and the steel sheet 8 is shorter than 0 mm (that is, an arrangement in which the intersection is not present on the steel sheet 8), it is difficult to blow off the coating film protrusion 9x which is the

excessive coating formed at the side edge 8x of the steel sheet 8. When the intersection exceeds 5 mm, it is difficult to smooth the coating film 9 after the excessive coating is blown off. More preferably, the intersection between the extension line 11a1 of the center axis line of the spray nozzle 11a and the steel sheet 8 is 0 mm or more and 3 mm or less.

[0038]

In addition, as a result of the test, the following knowledge was obtained. In a case where the blowing-off unit is adjusted so that the discharge flow rate of the gas discharged from the spray nozzle 11a is $12 \text{ m}^3/\text{h}$ or more and $20 \text{ m}^3/\text{h}$ or less, the discharge flow velocity of the gas discharged from the spray nozzle 11a at a position of 5 mm from the discharge port 11a3 which is the tip end of the spray nozzle 11a in the discharge direction when seen along the extension line 11a1 of the center axis line of the spray nozzle 11a is 420 m/s or more and 520 m/s or less, and the discharge flow velocity of the gas discharged from the spray nozzle 11a at a position of 5 mm from the point where the extension line 11a1 intersects the plane including the surface of the steel sheet 8 toward the spray nozzle 11a when seen along the extension line 11a1 of the center axis line of the spray nozzle 11a is 130 m/s or more and 520 m/s or less, the coating film protrusion 9x which is the excessive coating formed at the side edge 8x of the steel sheet 8 are reliably blown off and thus a flat coating film 9 can be obtained, which is more preferable. In addition, the discharge flow velocity of the gas discharged from the spray nozzle 11a may be measured by using a current meter. In addition, the discharge flow rate of the gas discharged from the spray nozzle 11a may be measured by using a flowmeter which is not illustrated in the drawings mounted to the spray nozzle 11a or may be obtained by a calculation using the measured discharge flow velocity, and the opening area of the discharge port 11a3 which is the tip end of

the spray nozzle 11a.

[0039]

When the discharge flow rate is less than $12 \text{ m}^3/\text{h}$, the discharge flow velocity of the gas at the position of 5 mm from the discharge port 11a3 in the discharge direction is less than 420 m/s, and the discharge flow velocity of the gas at the position of 5 mm from the intersection between the extension line 11a1 and the surface of the steel sheet 8 toward the spray nozzle 11a is less than 130 m/s, it is difficult to blow off the excessive coating. In addition, when the discharge flow rate exceeds $20 \text{ m}^3/\text{h}$, the discharge flow velocity of the gas at the position of 5 mm from the discharge port 11a3 in the discharge direction exceeds 520 m/s, and the discharge flow velocity of the gas at the position of 5 mm from the intersection between the extension line 11a1 and the surface of the steel sheet 8 toward the spray nozzle 11a exceeds 520 m/s, it is difficult to smooth the coating film 9 after the excessive coating is blown off. More preferably, the discharge flow rate is $14 \text{ m}^3/\text{h}$ or more and $16 \text{ m}^3/\text{h}$ or less, the discharge flow velocity of the gas at the position of 5 mm from the discharge port 11a3 in the discharge direction is 450 m/s or more and 490 m/s or less, and the discharge flow velocity of the gas at the position of 5 mm from the intersection between the extension line 11a1 and the surface of the steel sheet 8 toward the spray nozzle 11a is 160 m/s or more and 490 m/s or less. In addition, the discharge flow velocity and the discharge flow rate of the gas may be set to appropriate values in the above ranges according to the values of α , β , and d .

[0040]

In the spray-smoothing test, the spray nozzle 11a of which the shape when the discharge port 11a3 of the spray nozzle 11a is seen in a facing view is a circle is used. However, the shape of the discharge port 11a3 of the spray nozzle 11a is not limited to

a specific shape as long as the above discharge flow rate or discharge flow velocity can be maintained, and the shape when the discharge port 11a3 is seen in the facing view may be any of a circle, a rectangle, an ellipse, and a flat shape.

[0041]

In addition, in order to ensure a preferable discharge flow rate or discharge flow velocity to blow off the coating film protrusion 9x which is the excessive coating, the nozzle pressure of the spray nozzle 11a may be set in consideration of α , β , d , and the shape of the discharge port 11a3.

[0042]

In addition, the gas discharged from the spray nozzle 11a may be a gas that does not react with the coating 3. Air, inert gases, carbon dioxide, nitrogen gas, and the like are preferable, and in terms of cost, air is more preferable. The gas may be warmed to room temperature or higher. By warming the gas, the viscosity of the coating film 9 on the steel sheet 8 can be reduced, and thus the coating film protrusion 9x that is the excessive coating are reliably blown off and a flat coating film 9 can be obtained, which is more preferable. In the case of warming the gas, the gas is preferably warmed to 40°C or higher.

[0043]

FIGS. 3A to 3D are enlarged diagrams and illustrate an example in which a single spray nozzle 11a is disposed on one side edge 8x side of the steel sheet 8. However, two or more spray nozzles 11a may be arranged on both of side edge 8x sides of the steel sheet 8. For example, by arranging two spray nozzles 11a on one side edge 8x side of the steel sheet 8, a total of four spray nozzles 11a may be arranged on both sides of the side edge 8x of the steel sheet 8. In addition, in the case where two or more spray nozzles 11a are arranged, flow rate, flow velocity, nozzle pressure,

gas type, and the like between the plurality of spray nozzles 11a may be the same or may vary as long as the smoothing of the coating film 9 can be achieved by blowing off the coating film protrusion 9x which is the excessive coating.

[0044]

In addition, in the above-described spray-smoothing test, the high-viscosity coating 3 having a viscosity of 700 mPa·sec or higher and 2000 mPa·sec or lower is used. By using the high-viscosity coating 3 having a viscosity of 700 mPa·sec or higher and 2000 mPa·sec or lower, thickening of the coating film 9 can be achieved to a higher degree than that of the related art, and even in a case where the coating films 9 are stacked by the wet-on-wet method, the coatings 3 can be prevented from being mixed with each other and thus stacking of the coating films 9 is possible, which is preferable. Here, stacking of the coating films 9 according to the wet-on-wet method may be performed by, for example, in FIG. 1, installing two or more curtain coaters in series in the sheet threading direction C and forming, on a certain type of coating film, a different type of coating film.

[0045]

Test 2: Coating Collection Test

The present inventors performed a test for examining a coating collection status (coating collection test) under the same blowing-off conditions as those of the spray-smoothing test while changing the shapes and arrangement conditions of the duct 12a, the coating container 12b, and the gap 12c of the coating-collection unit 12 in various manners.

[0046]

As a result of the test, the following knowledge was found. When a size g of the gap 12c between the outlet 12a2 of the duct 12a and the opening 12b1 of the

coating container 12b, illustrated in FIG. 2, is 60 mm or more and 100 mm or less, the blown-off excessive coating is appropriately prevented from being reflected or flowing back, and re-adhering to the steel sheet 8, and the blown-off excessive coating can be collected by the coating container 12b.

[0047]

When the size g of the gap 12c is smaller than 60 mm, the amount of exhaust air from the gap 12c is not sufficient, and the internal pressure of the duct 12a and the coating container 12b is not released and increases too high. As a result, there is a possibility that the blown-off excessive coating may be reflected or flow back, and re-adhere to the steel sheet 8. When the size g of the gap 12c exceeds 100 mm, the interval between the outlet 12a2 of the duct 12a and the opening 12b1 of the coating container 12b is too large, and thus there is a possibility that the coating that falls into the opening 12b1 from the outlet 12a2 may flow along an air current in the atmosphere and may not be collected by the coating container 12b. Therefore, it is preferable that the size g of the gap 12c is 60 mm or more and 100 mm or less. More preferably, the size g of the gap 12c is 70 mm or more and 90 mm or less.

[0048]

In addition, as a result of the test, the following knowledge was obtained. Assuming that the opening area of the inlet 12a1 of the duct 12a is $Op1$ in units of mm^2 , the opening area of the outlet 12a2 of the duct 12a is $Op2$ in units of mm^2 , and the opening area of the opening 12b1 of the coating container 12b is $Op3$ in units of mm^2 , in a case where $Op1$ is $1.9 \times 10^5 mm^2$ or more and $6.4 \times 10^5 mm^2$ or less, $Op2$ is $1.3 \times 10^5 mm^2$ or more and $4.5 \times 10^5 mm^2$ or less, $Op3$ is $3.9 \times 10^5 mm^2$ or more and $1.4 \times 10^6 mm^2$ or less, and $Op3 > Op2$ and $Op1 > Op2$ are satisfied, the blown-off excessive coating is appropriately prevented from being reflected or flowing back and re-adhering to the

steel sheet 8, and the blown-off excessive coating can be collected by the coating container 12b.

[0049]

In a case where the opening area of each of Op1, Op2, and Op3 is smaller than the above range, there is a possibility that the blown-off excessive coating may be reflected or flow back and re-adhere to the steel sheet 8 and the blown-off excessive coating may not be reliably collected. In a case where the opening area of each of Op1, Op2, and Op3 exceeds the above range, the above-described effect is saturated and there is a problem in that the size of the coating-collection unit 12 itself becomes too large.

[0050]

In addition, in the case of $Op1 > Op2$, an air current in the duct 12a is rectified, and thus the blown-off excessive coating can be appropriately prevented from being reflected or flowing back and re-adhering to the steel sheet 8. In the case of $Op3 > Op2$, as described above, the blown-off excessive coating can be reliably collected by the coating container 12b. That is, it is preferable that the relationship between Op1, Op2, and Op3 satisfies $Op3 > Op2$ and $Op1 > Op2$.

[0051]

In addition, as a result of the test, the following knowledge was obtained. It is preferable that an extension member for receiving the excessive coating that is directed to the outside of the inlet be provided in the inlet 12a1 of the duct 12a. FIG. 4 is a diagram illustrating a modified example in which the extension member is provided in the inlet 12a1 of the duct 12a of the coating-collection unit 12 and is a side view corresponding to FIG. 2. As illustrated in FIG. 4, the extension member 12d is disposed in the inlet 12a1 so as to be directed to the outside of the inlet 12a1 of the

duct 12a and be concealed under the lower surface of the steel sheet 8. By providing the extension member 12d in the inlet 12a1 of the duct 12a, the excessive coating that is blown off the steel sheet 8 by the blowing-off unit 11 can be incorporated into the duct 12a.

[0052]

In the coating collection test described above, the duct 12a and the coating container 12b in which the shape of each of the openings thereof is a circle are used. However, the shapes of the duct 12a and the coating container 12b are not limited to the above shape, and the shape of each of the openings thereof when seen in a facing view may be any of a circle, a rectangle, an ellipse, and a flat shape.

[0053]

In addition, in the coating collection test described above, a single duct 12a and a single coating container 12b are arranged to be provided for a single spray nozzle 11a. However, the arrangement of the duct 12a and the coating container 12b is not limited thereto, and in a range that satisfies the above-described conditions, for example, an arrangement in which two ducts 12a and a single coating container 12b are provided for two spray nozzles 11a may be adopted.

[0054]

The device for producing a coated steel sheet of this embodiment described above will be summarized as follows.

(1) The device for producing a coated steel sheet in this embodiment includes: the blowing-off unit 11 which sprays the gas onto and remove the coating film protrusion 9x which is excessive coating that accumulates along the side edge 8x of the steel sheet 8 that threads along the sheet threading direction C; and the coating-collection unit 12 which collects the excessive coating removed by the blowing-off

unit 11. The blowing-off unit 11 includes the spray nozzle 11a which is directed in a direction from the inside to the outside in the sheet-width direction of the steel sheet 8 and directed toward the side edge 8x, and the gas supply member 11c which supplies the gas to the spray nozzle 11a. The coating-collection unit 12 includes the duct 12a having the inlet 12a1 that receives the excessive coating and the outlet 12a2 that discharges the received excessive coating, and the coating container 12b having the opening 12b1 that receives the excessive coating discharged from the outlet 12a2. In a case where the duct 12a is seen in the plan view, the outlet 12a2 is disposed to fit in and overlap the inside of the opening 12b1 of the coating container 12b, and in a case where the duct 12a is seen in a side view, the gap 12c is provided between the outlet 12a2 and the opening 12b1 of the coating container 12b.

[0055]

(2) In addition, when the angle between the extension line 11a1 of the center axis line of the spray nozzle 11a and the projection line 11a2 of the extension line 11a1 on the surface of the steel sheet 8 is β in units of degrees $^{\circ}$, the angle between the projection line 11a2 and the sheet threading direction C of the steel sheet 8 in a case where the surface is seen in a facing view is α in units of degrees $^{\circ}$, and the distance from the discharge port 11a3 which is the tip end of the spray nozzle 11a to the point that intersects the plane including the surface when seen along the extension line 11a1 is d in units of mm, all the following Expressions A, B, and C are satisfied, and the discharge direction of the spray nozzle 11a is disposed to be opposite to the sheet threading direction C of the steel sheet 8.

$$20^{\circ} \leq \alpha \leq 70^{\circ} \quad \dots (\text{Expression A})$$

$$20^{\circ} \leq \beta \leq 70^{\circ} \quad \dots (\text{Expression B})$$

$$10 \text{ mm} \leq d \leq 55 \text{ mm} \quad \dots (\text{Expression C})$$

(3) In addition, the size g of the gap 12c in a side view is 60 mm or more and 100 mm or less.

(4) In addition, the viscosity of the coating applied to the steel sheet 8 is 700 mPa·sec or higher and 2000 mPa·sec or lower.

[0056]

(5) In addition, the blowing-off unit is adjusted so that the discharge flow rate of the gas discharged from the spray nozzle 11a is 12 m³/h or more and 20 m³/h or less, the discharge flow velocity of the gas discharged from the spray nozzle 11a at a position of 5 mm from the tip end of the spray nozzle 11a in the discharge direction when seen along the extension line 11a1 of the center axis line of the spray nozzle 11a is 420 m/s or more and 520 m/s or less, and the discharge flow velocity of the gas discharged from the spray nozzle 11a at a position of 5 mm from the point where the extension line 11a1 intersects the plane including the surface of the steel sheet 8 toward the spray nozzle 11a when seen along the extension line 11a1 of the center axis line of the spray nozzle 11a is 130 m/s or more and 520 m/s or less.

(6) In addition, the inlet 12a1 of the duct 12a may be provided with the extension member 12d which receives the excessive coating directed to the outside of the inlet 12a1.

(7) In addition, the spray nozzle 11a is disposed so that the discharge direction of the gas is along with the sheet threading direction C when seen in the plan view and may further satisfy the following Expression E.

$$110^{\circ} \leq \alpha \leq 160^{\circ} \quad \dots (\text{Expression E})$$

(8) In addition, the spray nozzle 11a is disposed to further satisfy the following Expression D.

$$0.1 \leq \sin \alpha \cdot \cos \beta \leq 0.9 \quad \dots (\text{Expression D})$$

(9) In addition, the shape of the discharge port 11a3 of the spray nozzle 11a in a facing view is a circle. In addition, as described above, as necessary, the shape may be any of a rectangle, a circle, an ellipse, and a flat shape.

[0057]

Next, a method for producing a coated steel sheet according to an embodiment of the present invention will be described. However, the present invention is not limited to the following embodiment and can be modified in various forms in a range that does not depart from the gist of the present invention.

[0058]

The method for producing a coated steel sheet according to this embodiment of the present invention includes: a process of blowing off and removing the excessive coating that accumulates along the side edge 8x of the steel sheet 8 on which the coating 3 is applied; and a process of receiving and collecting the removed excessive coating by the coating container 12b via the duct 12a having the inlet 12a1 and the outlet 12a2. In addition, the internal pressure of the duct 12a is released from the gap 12c between the outlet 12a2 of the duct 12a and the opening 12b1 of the coating container 12b.

[0059]

By the method for producing a coated steel sheet according to this embodiment described above, the excessive coating that accumulates along the side edge 8x of the steel sheet 8 is blown off and removed, the blown-off excessive coating is prevented from being reflected or flowing back and re-adhering to the steel sheet 8, and the blown-off excessive coating can be reliably collected.

[0060]

In addition, in the method for producing a coated steel sheet according to this

embodiment, since the high-viscosity coating 3 in which the viscosity of the coating 3 applied to the steel sheet 8 is 700 mPa·sec or higher and 2000 mPa·sec or lower is used, the thickening of the coating film 9 can be achieved to a higher degree than that of the related art, and even in a case where the coating films 9 are stacked by the wet-on-wet method, the coatings can be prevented from being mixed with each other and thus the stacking of the coating films can be achieved.

[Example 1]

[0061]

Next, Examples of the present invention will be described. However, the conditions of the Examples are only a condition example that is adopted to check a possibility of embodying the present invention and the effect thereof, and the present invention is not limited to the condition examples. The present invention can adopt various conditions as long as the object of the present invention can be achieved without departing from the gist of the present invention.

[0062]

A high-viscosity coating having a viscosity of 1700 mPa·sec was used, and the coating was applied onto a steel sheet by a blade type curtain coater. After the application, a blowing-off unit and a coating-collection unit arranged under the conditions shown in Table 1 blew off and removed coating film protrusion which is the excessive coating that accumulates on the side edge of the steel sheet under the spray condition shown in Table 1. The results are also shown in Table 1. In addition, in Table 1, the discharge flow velocity of gas in a discharge direction at a position of 5 mm from the tip end of a spray nozzle in the discharge direction when seen along an extension line of a center axis line of the spray nozzle is referred to as a discharge flow velocity 1, and the discharge flow velocity of the gas in the discharge direction at a

position of 5 mm from a point where the extension line and the surface of the steel sheet intersect toward the spray nozzle is referred to as a discharge flow velocity 2.

[0063]

[Table 1]

[0064]

From Table 1, it is seen that, in Examples 1 to 5, after the coating film protrusion which is the excessive coating is blown off, the film thickness of the coating film at the side edge of the steel sheet is flat.

[0065]

FIG. 5 is a diagram illustrating Example 1 shown in Table 1, is a photograph of the side edge part of the steel sheet when viewed in a cross section perpendicular to the sheet threading direction thereof, and is a cross-sectional photograph taken at positions of 0 mm, 10 mm, and 15 mm from the side edge of the steel sheet toward the inside in the sheet-width direction. This cross-sectional photograph was observed by a scanning electron microscope (SEM). Reference sign 8 denotes the steel sheet and reference sign 9 denotes the coating film in FIG. 5. As shown in FIG. 5, it is seen that in a range of 15 mm from the side edge of the steel sheet toward the inside in the sheet-width direction, the coating film protrusion is removed and thus the film thickness of the coating film is flat.

[Industrial Applicability]

[0066]

According to the embodiments of the present invention, the excessive coating that accumulates along the side edge of the steel sheet is blown off and removed, the blown-off coating is prevented from being reflected or flowing back and re-adhering to the steel sheet and the blown-off coating can be reliably collected. As a result,

without a reduction in production efficiency or a limitation to the product shipping form, external appearance failure of the coated steel sheet does not occur. Therefore, it is possible to achieve thickening of the coating film to a higher degree than that of the related art, stacking of coating films in which the generation of a mixed layer of coatings is suppressed, and the like, resulting in a high industrial applicability.

[Reference Signs List]

[0067]

1	APPLICATOR ROLL
2	DOCTOR ROLL
3	COATING
3a	COATING CURTAIN
4	BLADE
5	CURTAIN GUIDE
6	COATING PAN
7	SUPPORT ROLL
8	STEEL SHEET
8x	SIDE EDGE OF STEEL SHEET
9	COATING FILM
9x	COATING FILM PROTRUSION (EXCESSIVE

COATING)

11	BLOWING-OFF UNIT
11a	SPRAY NOZZLE
11b	GAS SUPPLY PIPE
11c	GAS SUPPLY MEMBER
11a1	EXTENSION LINE OF CENTER AXIS LINE OF SPRAY

NOZZLE

11a2	PROJECTION LINE OF SPRAY NOZZLE
11a3	DISCHARGE PORT OF SPRAY NOZZLE
12	COATING-COLLECTION UNIT
12a	DUCT
12a1	INLET OF DUCT
12a2	OUTLET OF DUCT
12b	COATING CONTAINER
12b1	OPENING OF COATING CONTAINER
12c	GAP
12d	EXTENSION MEMBER
g	SIZE OF GAP
A	ROTATIONAL DIRECTION OF APPLICATOR ROLL
B	ROTATIONAL DIRECTION OF DOCTOR ROLL
C	SHEET THREADING DIRECTION OF STEEL SHEET

[Document Type]

CLAIMS

[Claim 1]

A device for producing a coated steel sheet, comprising:

a blowing-off unit which sprays a gas onto and remove an excessive coating that accumulates along a side edge of a steel sheet that threads along one direction; and

a coating-collection unit which collects the excessive coating removed by the blowing-off unit,

wherein the blowing-off unit includes a spray nozzle which is directed in a direction from an inside to an outside in a sheet-width direction of the steel sheet and directed toward the side edge, and a gas supply member which supplies the gas to the spray nozzle,

the coating-collection unit includes a duct having an inlet that receives the excessive coating and an outlet that discharges the received excessive coating, and a coating container having an opening that receives the excessive coating discharged from the outlet, and

in a case where the duct is seen in a plan view, the outlet is disposed to fit in and overlap an inside of the opening of the coating container, and in a case where the duct is seen in a side view, a gap is provided between the outlet and the opening of the coating container.

[Claim 2]

The device for producing a coated steel sheet according to Claim 1,

wherein, when an angle between an extension line of a center axis line of the spray nozzle and a projection line of the extension line on a surface of the steel sheet is defined as β , an angle between the projection line and a sheet threading direction of the steel sheet in a case where the surface is seen in a facing view is defined as α , and a

distance from a tip end of the spray nozzle to a point that intersects a plane including the surface when seen along the extension line is defined as d in units of mm, all the following Expressions 1, 2, and 3 are satisfied, and a discharge direction of the spray nozzle is disposed to be opposite to the sheet threading direction of the steel sheet.

$$20^{\circ} \leq \alpha \leq 70^{\circ} \quad \dots(\text{Expression 1})$$

$$20^{\circ} \leq \beta \leq 70^{\circ} \quad \dots(\text{Expression 2})$$

$$10 \text{ mm} \leq d \leq 55 \text{ mm} \quad \dots(\text{Expression 3})$$

[Claim 3]

The device for producing a coated steel sheet according to Claim 1,
wherein a size of the gap in a side view is 60 mm or more and 100 mm or less.

[Claim 4]

The device for producing a coated steel sheet according to Claim 1,
wherein a viscosity of the coating applied to the steel sheet is 700 mPa·sec or higher and 2000 mPa·sec or lower.

[Claim 5]

The device for producing a coated steel sheet according to Claim 1,
wherein the blowing-off unit is adjusted so that a discharge flow rate of the gas discharged from the spray nozzle is 12 m³/h or more and 20 m³/h or less, a discharge flow velocity of the gas discharged from the spray nozzle at a position of 5 mm from a tip end of the spray nozzle in a discharge direction when seen along an extension line of a center axis line of the spray nozzle is 420 m/s or more and 520 m/s or less, and a discharge flow velocity of the gas discharged from the spray nozzle at a position of 5 mm from a point where the extension line intersects a plane including a surface of the steel sheet toward the spray nozzle when seen along the extension line of the center axis line of the spray nozzle is 130 m/s or more and 520 m/s or less.

[Claim 6]

The device for producing a coated steel sheet according to Claim 1,
wherein the inlet of the duct is provided with an extension member which
receives the excessive coating directed to an outside of the inlet.

[Claim 7]

The device for producing a coated steel sheet according to Claim 2,
wherein the spray nozzle is disposed so that the discharge direction of the gas
is along with the sheet threading direction when seen in the plan view.

[Claim 8]

The device for producing a coated steel sheet according to Claim 2,
wherein the spray nozzle is disposed so as to further satisfy the following
Expression 4.

$$0.1 \leq \sin \alpha \cdot \cos \beta \leq 0.9 \quad \dots (\text{Expression 4})$$

[Claim 9]

The device for producing a coated steel sheet according to Claim 1,
wherein a shape of a discharge port of the spray nozzle in a facing view is any
of a rectangle, a circle, an ellipse, and a flat shape.

[Claim 10]

A method for producing a coated steel sheet, the method comprising:
blowing off and removing an excessive coating that accumulates along a side
edge of a steel sheet on which a coating is applied; and
receiving and collecting the removed excessive coating by a coating container
via a duct having an inlet and an outlet,
wherein an internal pressure of the duct is released from a gap between the
outlet of the duct and an opening of the coating container.

[Claim 11]

The method for producing a coated steel sheet according to Claim 10,
wherein a viscosity of the coating applied to the steel sheet is 700 mPa·sec or
higher and 2000 mPa·sec or lower.

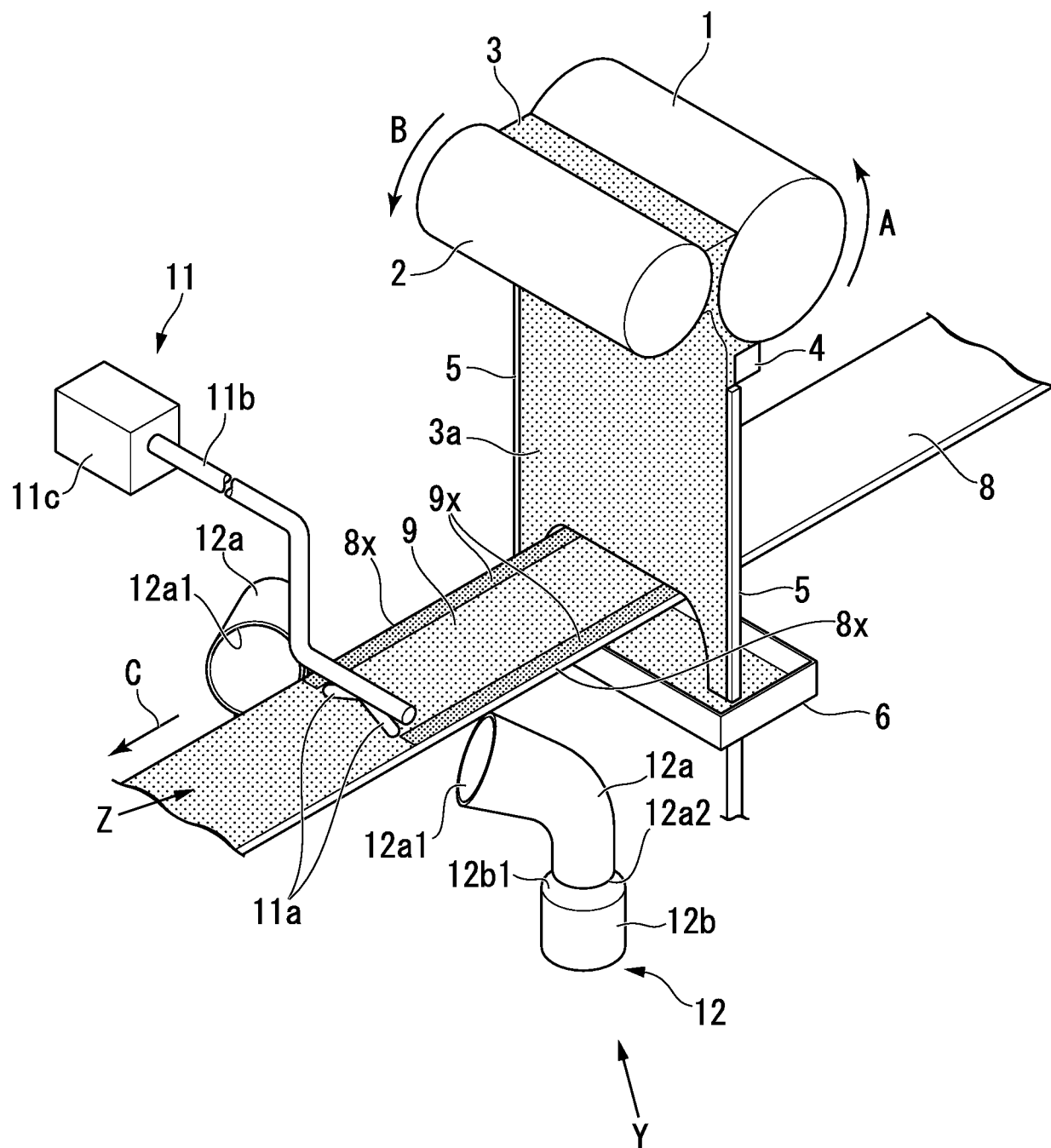


FIG. 2

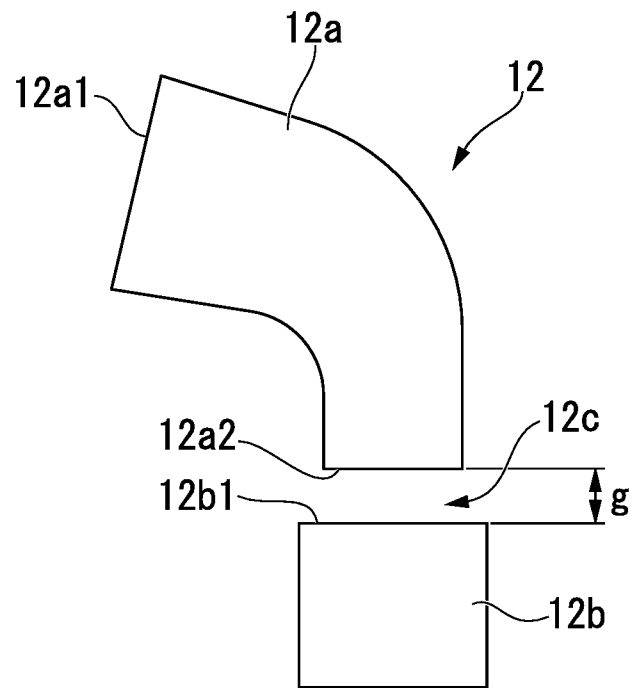


FIG. 3A

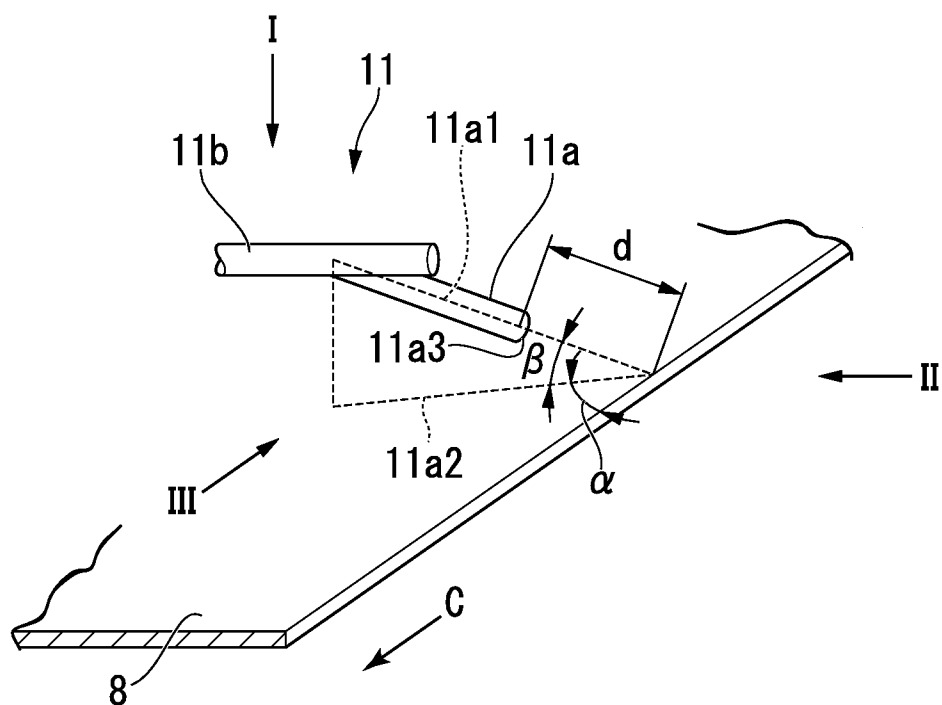


FIG. 3B

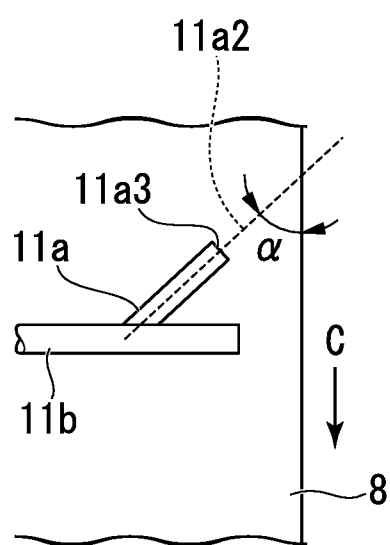


FIG. 3C

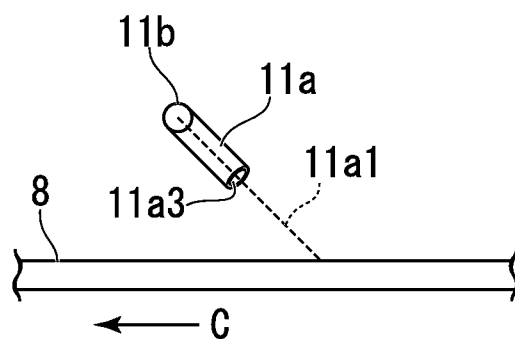


FIG. 3D

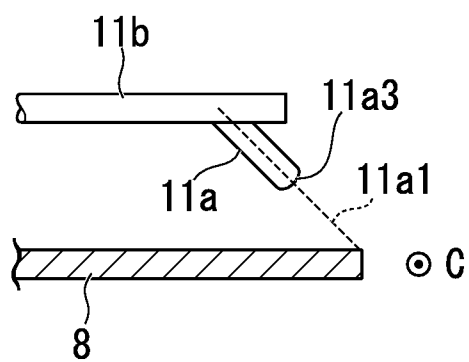


FIG. 4

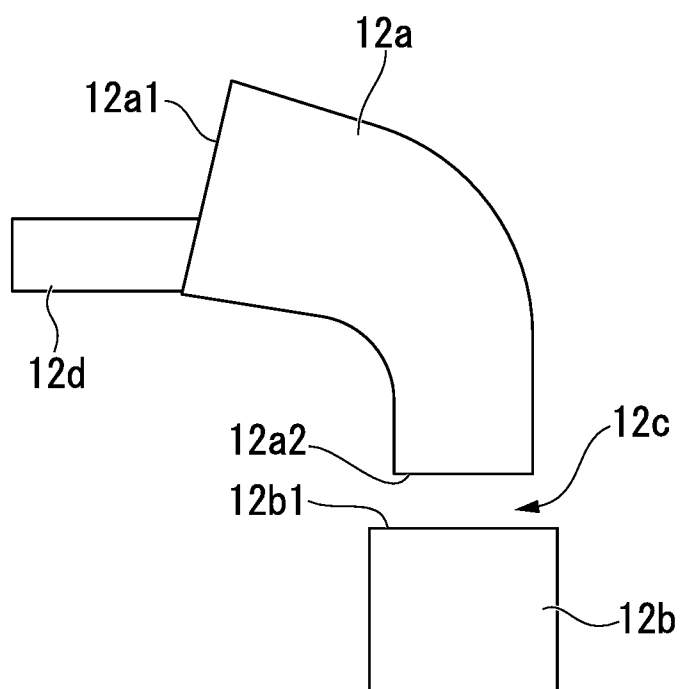


FIG. 5

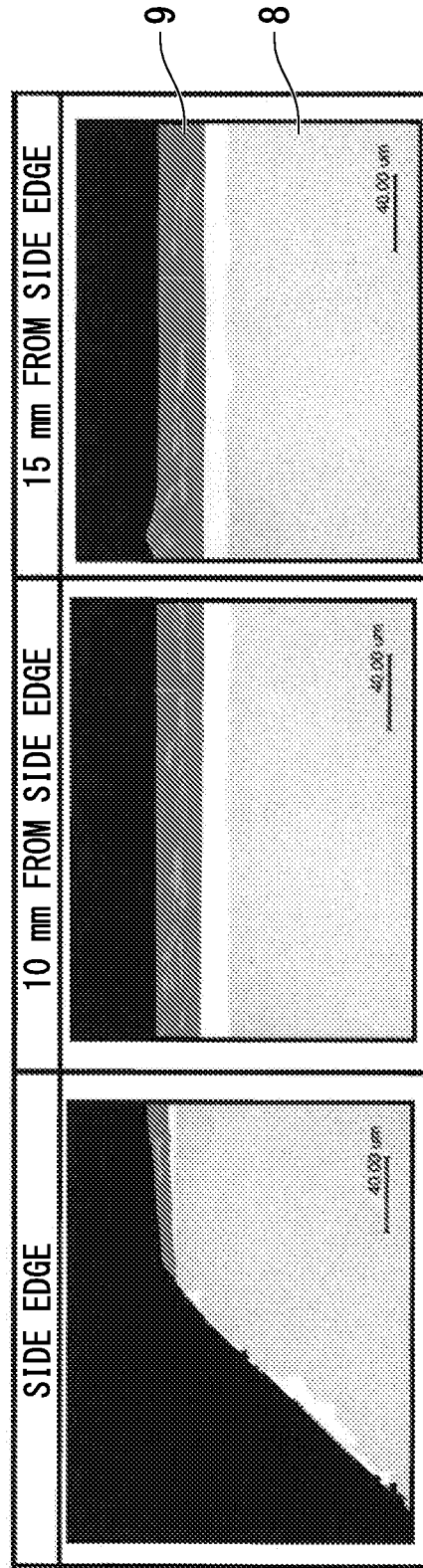


FIG. 6

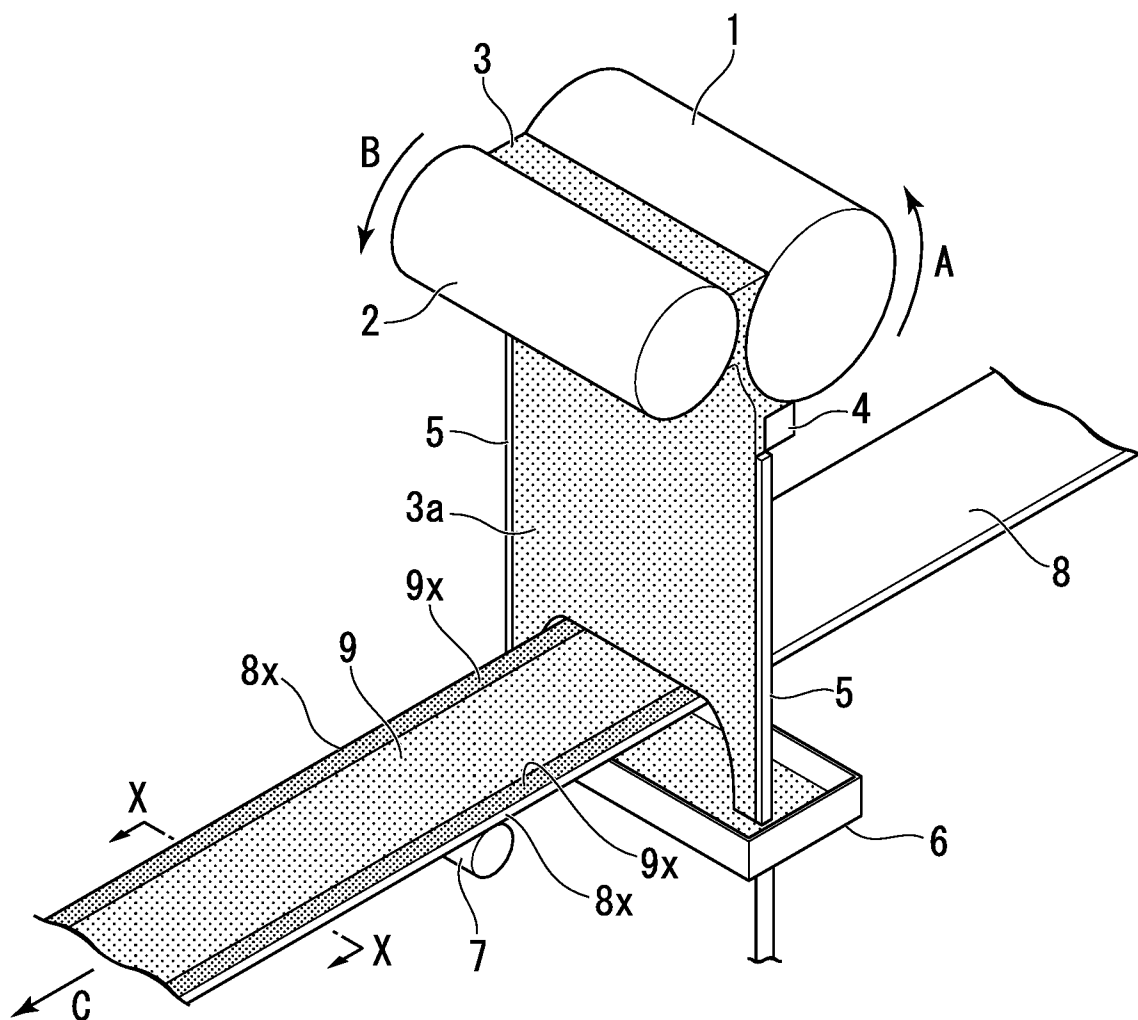


FIG. 7

