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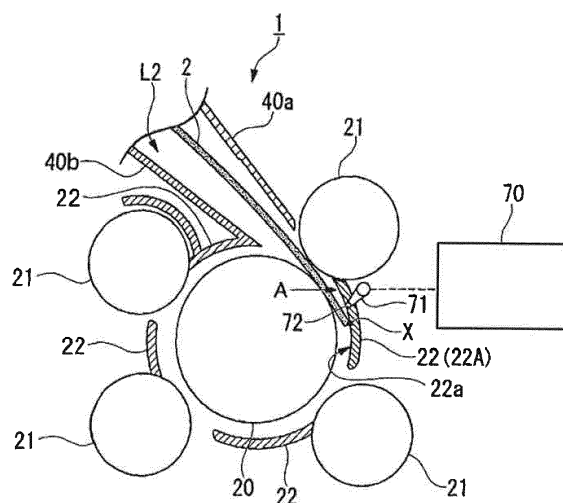
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(54) **COILER DEVICE PROVIDED WITH WRAPPER APRONS**

(57) This coiler device (1) provided with wrapper aprons (22) has: a mandrel (20) that coils up a metal sheet (2); a plurality of wrapper rollers (21) that coil the metal sheet (2) to the mandrel (20); and a plurality of wrapper aprons (22) that guide the leading end of the metal sheet (2) between adjacent wrapper rollers (21). A configuration is adopted having a fluid supply device (70) that supplies a fluid to the guide surfaces (22a) of the wrapper apron (22A) disposed at the most upstream side with respect to the coiling of the metal sheet (2).

FIG.2



Description

TECHNICAL FIELD

[0001] The present invention relates to a coiler device provided with wrapper aprons.

BACKGROUND ART

[0002] In general, a coiler device (a winder) is provided on an exit side of a rolling line, and is configured to wind a metal strip (a strip) into a coil shape, where the metal strip is rolled by a rolling mill and continuously supplied from a gap between rollers. The coiler device is provided with pinch rollers located on a pass line for the metal strip, and is configured to cause the pinch rollers to guide the metal strip to a winding line which is bent obliquely downward from the pass line, to allow a leading end of the metal strip to be caught by a mandrel, and to wind up the metal strip (see Patent Document 1).

[0003] Patent Document 1 cited below discloses a method and an apparatus for winding a strip, which are designed to wind a rolled strip around a mandrel. The coiler device includes multiple wrapper rollers and wrapper aprons located around the mandrel, and is configured to guide the leading end of the metal strip by using the wrapper aprons and to wrap the metal strip around the mandrel by using the wrapper rollers.

PRIOR ART DOCUMENT PATENT DOCUMENT

[0004] Patent Document 1: Japanese Patent Application Publication No. 2005-305452

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005] Each wrapper apron has a curved guide surface. When the metal strip is wrapped around the mandrel, the leading end of the metal strip is thrust at the guide surface. The leading end of the metal strip thrust at the guide surface is bent into a curved shape. Thus, it is possible to wrap the leading end of the metal strip stably around the mandrel by using the wrapper rollers disposed on a downstream side. However, when the metal strip is a high-strength thick material, a large pushing force is required for bending the leading end of the metal strip with the wrapper aprons due to high bending stiffness of the metal strip. As a consequence, frictional resistance applied to each wrapper apron is increased whereby the guide surface becomes vulnerable to a flaw. At the same time, energy consumption is also increased since the large pushing force is required.

[0006] The present invention has been made in view of the above-mentioned problem. An object of the present invention is to provide a coiler device provided with wrapper aprons, which is capable of winding a metal strip

around a mandrel without applying a large pushing force even when the metal strip is a high-strength thick material.

MEANS FOR SOLVING THE PROBLEMS

[0007] In order to solve the problem described above, the present invention adopts a configuration of a coiler device provided with wrapper aprons, characterized by: a mandrel configured to wind up a metal strip; a plurality of wrapper rollers configured to wrap the metal strip around the mandrel; and a plurality of wrapper aprons configured to guide a leading end of the metal strip in spaces between the adjacent wrapper rollers. The coiler device includes a fluid supply device configured to supply a fluid to a guide surface of the wrapper apron disposed on the most upstream side from the viewpoint of winding the metal strip. As a consequence of adopting this configuration, in the present invention, the fluid is supplied to the guide surface of the wrapper apron disposed on the most upstream side from the viewpoint of winding the metal strip, and frictional resistance against the leading end of the metal strip is thus reduced. The wrapper apron disposed on the most upstream side from the viewpoint of winding the metal strip is the first to bend the leading end of the metal strip, so that the largest force is applied thereto. Accordingly, by reducing the frictional resistance on the wrapper apron, it is possible to reduce energy consumption since the metal strip does not require a very large pushing force.

[0008] In addition, the present invention adopts a configuration in which the fluid supply device includes a fluid supply port formed in the guide surface. As a consequence of adopting this configuration, in the present invention, the fluid can be supplied from a back side of the wrapper apron to the guide surface by forming the fluid supply port in the guide surface. This makes it possible to supply the fluid directly to the guide surface of the wrapper apron without the need to dispose an obstacle on a pathway of the metal strip.

[0009] In addition, the present invention adopts a configuration in which the fluid supply port is formed on an upstream side, from the viewpoint of winding the metal strip, of a position where the leading end of the metal strip first comes into contact with the guide surface. As a consequence of adopting this configuration, in the present invention, it is possible to prevent the leading end of the metal strip from getting caught on the fluid supply port by disposing the fluid supply port on the upstream side of a position where the leading end of the metal strip first comes into contact with the guide surface.

[0010] In addition, the present invention adopts a configuration in which the fluid supply port is directed to a downstream side from the viewpoint of winding the metal strip. As a consequence of adopting this configuration, in the present invention, it is possible to supply the fluid from the fluid supply port along the guide surface, and to cause the fluid to flow toward the position on the down-

stream side where the leading end of the metal strip first comes into contact with the guide surface.

[0011] In addition, the present invention adopts a configuration in which the fluid supply device is configured to supply the fluid indirectly to the guide surface by spraying the fluid to the metal strip. As a consequence of adopting this configuration, in the present invention, it is possible to further reduce the frictional resistance on the guide surface of the wrapper apron by supplying the fluid to the metal strip side as well.

[0012] In addition, the present invention adopts a configuration in which the fluid supply device includes: first fluid supply ports configured to supply the fluid directly to the guide surface; and second fluid supply ports configured to supply the fluid indirectly to the guide surface by spraying the fluid to the metal strip, and the first fluid supply ports and the second fluid supply ports are formed in a staggered configuration in the guide surface. As a consequence of adopting this configuration, in the present invention, by forming the first fluid supply ports and the second fluid supply ports in the staggered configuration, it is possible to cover a portion between two first fluid supply ports, which is prone to insufficient supply of the fluid, with the indirect supply of the fluid from the corresponding second fluid supply port.

EFFECT OF THE INVENTION

[0013] According to the present invention, it is possible to obtain a coiler device provided with wrapper aprons, which is capable of winding a metal strip around a mandrel without applying a large pushing force even when the metal strip is a high-strength thick material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

[Fig. 1] Fig. 1 is an overall configuration diagram showing a coiler device according to a first embodiment of the present invention.

[Fig. 2] Fig. 2 is an enlarged diagram of substantial part showing the coiler device according to the first embodiment of the present invention.

[Fig. 3] Fig. 3 is a diagram viewed along an arrow A in Fig. 2.

[Fig. 4] Fig. 4 is an enlarged diagram of substantial part showing a coiler device according to a second embodiment of the present invention.

[Fig. 5] Fig. 5 is a diagram viewed along an arrow B in Fig. 4.

MODES FOR CARRYING OUT THE INVENTION

[0015] Embodiments of the present invention will be described below with reference to the drawings.

[0016] (First Embodiment) Fig. 1 is an overall configuration diagram showing a coiler device 1 according to

a first embodiment of the present invention. Fig. 2 is an enlarged diagram of substantial part showing the coiler device 1 according to the first embodiment of the present invention. Fig. 3 is a diagram viewed along an arrow A in Fig. 2. As shown in Fig. 1, the coiler device 1 is disposed on a downstream side of a not-illustrated rolling mill, and is configured to introduce a metal strip 2, which passes through the rolling mill and is conveyed along a pass line L1, to a winding line L2 and thereby winding up the metal strip 2. The pass line L1 is defined by multiple conveyance rollers 3 that are arranged horizontally.

[0017] The coiler device 1 includes pinch rollers 10a and 10b. The pinch rollers 10a and 10b are designed to guide the metal strip 2, which is conveyed along the pass line L1, to the winding line L2 that is bent from the pass line L1. The winding line L2 extends obliquely downward from the pass line L1. The upper pinch roller 10a is made capable of approaching and receding from the lower pinch roller 10b. The upper pinch roller 10a is designed to recede from the lower pinch roller 10b except in the case of winding the metal strip 2 around a mandrel 20 to be described below.

[0018] The coiler device 1 includes the mandrel 20. The mandrel 20 is disposed ahead of the winding line L2 and designed to wind up the metal strip 2. Multiple wrapper rollers 21 and wrapper aprons 22 are provided around the mandrel 20. The wrapper rollers 21 are provided for wrapping the metal strip 2 around the mandrel 20. The wrapper rollers 21 are disposed at intervals in a circumferential direction of the mandrel 20. The wrapper rollers 21 are made capable of approaching and receding from the mandrel 20. The wrapper rollers 21 are designed to move in conformity with a diameter of the metal strip 2 wrapped around the mandrel 20.

[0019] The wrapper aprons 22 are designed to guide a leading end of the metal strip 2 when the metal strip 2 is wrapped around the mandrel 20. Each wrapper apron 22 has a guide surface 22a, which is opposed to a peripheral surface of the mandrel 20, and allows the leading end of the metal strip 2 to come into contact therewith. The guide surface 22a is curved along the peripheral surface of the mandrel 20. Each wrapper apron 22 is disposed in a space between two corresponding wrapper rollers 21 adjacent to each other in the circumferential direction of the mandrel 20. The wrapper aprons 22 are made capable of approaching and receding from the mandrel 20. The wrapper aprons 22 are designed to recede from the mandrel 20 when the metal strip 2 is wrapped therearound.

[0020] The coiler device 1 includes a gate 30. The gate 30 is configured to open and close the winding line L2 (Fig. 1 shows an open state). The gate 30 is disposed on an exit side of the pinch rollers 10a and 10b. The gate 30 includes a first guide surface 31 that defines the pass line L1, and a second guide surface 32 that defines the winding line L2. The first guide surface 31 is formed into a horizontal surface extending along the pass line L1. The second guide surface 32 is formed into an inclined

surface extending along the winding line L2. The gate 30 has a structure in which a tip end of a substantially V shape is directed to an upstream side of the pass line L1.

[0021] The gate 30 defines the winding line L2 in conjunction with chute guides 40a and 40b. The chute guides 40a and 40b are designed to guide the leading end of the metal strip 2 to a catch part between the mandrel 20 and the corresponding wrapper roller 21. The chute guides 40a and 40b are arranged in a downward tapered fashion such that a clearance therebetween is gradually narrowed toward the catch part between the mandrel 20 and the wrapper roller 21. The chute guides 40a and 40b are disposed on a downstream side of the gate 30 in the winding line L2. In this embodiment, the lower chute guide 40b is provided integrally with one of the wrapper aprons 22.

[0022] The coiler device 1 includes a chute roller 50. The chute roller 50 is configured to suppress a deformation of the metal strip 2 in such a way as to be curved toward its upper surface side when the leading end of the metal strip 2 is wrapped around the mandrel 20. The chute roller 50 is disposed at a position corresponding to a joint between the gate 30 and the upper chute guide 40a, which is disposed on the downstream side of the gate 30 on the winding line L2. The chute roller 50 is rotatably provided and its peripheral surface projects from the second guide surface 32.

[0023] The coiler device 1 includes a bending roller 60. The bending roller 60 is disposed on an upstream side of the pinch rollers 10a and 10b, and is made capable of approaching and receding from the pass line L1 by use of a bending roller drive device 61. The bending roller 60 is configured to approach the pass line L1 when the rolling of the metal strip 2 is about to finish, so as to prevent its trailing end from bouncing up. The bending roller drive device 61 is formed from a cylinder device, for example.

[0024] The coiler device 1 includes a fluid supply device 70. The fluid supply device 70 is configured to supply a fluid to the guide surface 22a of the wrapper apron 22 (which may be hereinafter referred to as a wrapper apron 22A as appropriate) disposed on the most upstream side from the viewpoint of winding the metal strip 2. The fluid supply device 70 is configured to supply the fluid through nozzles 71. Here, a gas, a liquid or a powder can be employed as the fluid to be supplied from the nozzles 71. This embodiment employs a liquid, which is more apt to stay on the guide surface 22a. Water or lubricant oil can be suitably employed as the liquid.

[0025] As shown in Fig. 2, the fluid supply device 70 includes fluid supply ports 72 formed in the guide surface 22a. The fluid supply ports 72 are formed to penetrate the wrapper apron 22A in the thickness direction. The nozzles 71 are inserted into the fluid supply ports 72. Accordingly, the fluid supply device 70 can supply the fluid to the guide surface 22a through the fluid supply ports 72. As shown in Fig. 3, the multiple fluid supply ports 72 are formed in an arrayed fashion in a width direction of the wrapper apron 22A.

[0026] The fluid supply ports 72 are formed on an upstream side (an upper side in Fig. 3), from the viewpoint of winding the metal strip 2, of a position where the leading end of the metal strip 2 first comes into contact with the guide surface 22a (which is indicated as a contact position X in Fig. 3). In terms of Fig. 2, the contact position X can be defined as a position where a tangent that is common to the peripheral surface of the mandrel 20 and a peripheral surface of the first wrapper roller 21 (an entry pathway of the leading end of the metal strip 2) meets the guide surface 22a of the wrapper apron 22A. The fluid supply ports 72 are formed above the contact position X.

[0027] As shown in Fig. 2, the fluid supply ports 72 are formed in such a way as to be directed to a downstream side (obliquely downward) from the viewpoint of winding the metal strip 2. Each fluid supply port 72 is formed obliquely with respect to a normal direction of the curved guide surface 22a, and exhibits an elongated hole shape on the guide surface 22a as shown in Fig. 3. The fluid supplied from the fluid supply ports 72 flows along the guide surface 22a and is supplied to the contact position X. The array of the fluid supply ports 72 is formed longer than a width of contact of the metal strip 2 with the guide surface 22a, so that the fluid can be supplied to the entire contact position X.

[0028] Next, an operation to wind the metal strip 2 by the coiler device 1 configured as described above will be explained. Note that a description is given below of a case where the metal strip 2 is a high-strength thick material.

[0029] As shown in Fig. 1, the metal strip 2 having passed through the not-illustrated rolling mill is conveyed along the pass line L1 and reaches the pinch rollers 10a and 10b. After having passed through the pinch rollers 10a and 10b, the metal strip 2 changes its passing angle obliquely downward and is hence guided to the winding line L2 which is bent from the pass line L1. The metal strip 2 passes through a space between the chute guides 40a and 40b while being subjected to friction reduction by means of rotation of the chute roller 50, and is then guided to the catch part between the mandrel 20 and the wrapper roller 21.

[0030] As shown in Fig. 2, the leading end of the metal strip 2 having passed through the space between the mandrel 20 and the wrapper roller 21 comes into contact with the curved guide surface 22a of the wrapper apron 22A. Here, when the metal strip 2 is the high-strength thick material, the leading end of the metal strip 2 is not bent very much by the engagement with one wrapper roller 21 only. Hence, a large pushing force is required in order to break a constraint attributed to a static frictional force between the leading end of the metal strip 2 and the wrapper apron 22A.

[0031] The fluid supply device 70 supplies the fluid to the guide surface 22a of the wrapper apron 22A disposed on the most upstream side from the viewpoint of winding the metal strip 2, thereby reducing frictional resistance

against the leading end of the metal strip 2. The wrapper apron 22A is the first to bend the leading end of the metal strip 2, so that the largest force is applied thereto. For this reason, by reducing the frictional resistance on the wrapper apron 22A by the action of the fluid such as water and lubricant oil, it is possible to reduce energy consumption since the metal strip 2 does not require a very large pushing force. Moreover, by interposing the fluid between the leading end of the metal strip 2 and the guide surface 22a, it is possible to prevent occurrence of a flaw on the guide surface 22a.

[0032] The fluid supply device 70 of this embodiment is provided with the fluid supply ports 72 formed in the guide surface 22a, and is configured to supply the fluid from a back side of the wrapper apron 22A to the guide surface 22a. This configuration makes it possible to supply the fluid directly to the guide surface 22a of the wrapper apron 22A without the need to dispose an obstacle on the pathway of the metal strip 2. Moreover, the fluid supply ports 72 are formed on the upstream side, from the viewpoint of winding the metal strip 2, of the contact position X where the leading end of the metal strip 2 first comes into contact with the guide surface 22a. Accordingly, it is possible to supply the fluid while preventing the leading end of the metal strip 2 from getting caught on the fluid supply ports 72.

[0033] Furthermore, the fluid supply ports 72 are directed to the downstream side from the viewpoint of winding the metal strip 2. This configuration makes it possible to cause the fluid that is supplied from the fluid supply ports 72 to flow along the guide surface 22a. The fluid having flowed along the guide surface 22a is supplied to the portion of the guide surface 22a on the downstream side of the fluid supply ports 72, the portion covering the contact position X, and acts on the guide surface 22a so as to reduce the frictional resistance against the leading end of the metal strip 2. By the action of the fluid, the leading end of the metal strip 2 released from the constraint attributed to the static frictional force between the metal strip 2 and the wrapper apron 22 slides on the guide surface 22a of the wrapper apron 22, then comes into engagement with the subsequent wrapper roller 21 disposed on the downstream side thereof, and is wound around the mandrel 20. Thereafter, the operation to wind the metal strip 2 is completed when the metal strip 2 is successfully wrapped around the mandrel 20 in a predetermined diameter by using the wrapper rollers 21.

[0034] As described above, the above-described embodiment adopts the configuration of the coiler device 1 provided with the wrapper aprons 22, including: the mandrel 20 configured to wind up the metal strip 2; the multiple wrapper rollers 21 configured to wrap the metal strip 2 around the mandrel 20; and the multiple wrapper aprons 22 configured to guide the leading end of the metal strip 2 in the spaces between the adjacent wrapper rollers 21, in which the coiler device 1 includes the fluid supply device 70 configured to supply the fluid to the guide surface 22a of the wrapper apron 22A disposed on the most up-

stream side from the viewpoint of winding the metal strip 2. Thus, it is possible to obtain the coiler device 1 provided with the wrapper aprons 22, which is capable of winding the metal strip 2 around the mandrel 20 without applying the large pushing force even when the metal strip 2 is the high-strength thick material.

[0035] (Second Embodiment) Next, a second embodiment of the present invention will be described. In the following description, constituents which are identical or similar to those in the above-mentioned embodiment will be denoted by the same reference numerals and the description thereof will be either simplified or omitted.

[0036] Fig. 4 is an enlarged diagram of substantial part showing the coiler device 1 according to the second embodiment of the present invention. Fig. 5 is a diagram viewed along an arrow B in Fig. 4. As shown in Fig. 4, the fluid supply device 70 of the second embodiment is configured to spray the fluid to the metal strip 2 and thus to supply the fluid indirectly to the guide surface 22a.

[0037] The fluid supply device 70 includes second fluid supply ports 728 on an upstream side, from the viewpoint of winding the metal strip 2, of the fluid supply ports 72 (hereinafter referred to as first fluid supply ports 72A). The nozzles 71 (hereinafter referred to as first nozzles 71A) are inserted into the first fluid supply ports 72A while second nozzles 71B are inserted into the second fluid supply ports 72B. The second nozzles 71B are configured to be capable of ejecting the fluid as a spray. Each second fluid supply port 72B is formed to extend in the normal direction of the guide surface 22a, and exhibits a shape of a circular hole as shown in Fig. 5.

[0038] The first fluid supply ports 72A and the second fluid supply ports 728 are formed in a staggered configuration in the guide surface 22a. Specifically, the second fluid supply ports 728 form an array parallel to the array of the first fluid supply ports 72A, and each second fluid supply port 72B is disposed between the corresponding two first fluid supply ports 72A. As shown in Fig. 4, tip ends of the second nozzles 71B are inserted into the respective second fluid supply ports 72B and to positions therein which are near the guide surface 22a, so that the fluid can be sprayed to the metal strip 2 without losing a velocity.

[0039] According to the second embodiment having the above-mentioned configuration, the fluid can be supplied indirectly to the guide surface 22a by spraying the fluid from the second fluid supply ports 72B to the metal strip 2. By supplying the fluid also to the metal strip 2 side as described above, it is possible to sufficiently supply the fluid to the guide surface 22a of the wrapper apron 22A and to further reduce the frictional resistance. Moreover, by forming the first fluid supply ports 72 and the second fluid supply ports 72 in the staggered configuration as shown in Fig. 5, it is possible to cover a portion on the guide surface 22a between any two first fluid supply ports 72, which is prone to insufficient supply of the fluid, with the indirect supply of the fluid from the corresponding second fluid supply port 72. In this way, accord-

ing to the above-described second embodiment, the fluid can be sufficiently supplied to the guide surface 22a. Thus, it is possible to further reduce energy consumption since the metal strip 2 does not require a very large pushing force.

[0040] The preferred embodiments of the present invention have been described above with reference to the drawings. It is to be understood, however, that the present invention is not limited only to the above-described embodiments. The shapes, combinations, and other features of the respective constituents shown in the above-described embodiments are mere examples, and various modifications based on design requirements and the like are possible within the range not departing from the gist of the present invention.

[0041] For example, the embodiments have described the configuration in which the fluid supply device supplies the fluid through the fluid supply ports formed in the guide surface. However, the present invention is not limited only to this configuration. For instance, as long as an installation space is available, nozzles for supplying the fluid may be disposed on the guide surface side where the metal strip passes through.

[0042] Meanwhile, for example, the embodiments have described the configuration in which the fluid supply device continuously supplies the fluid to the guide surface until the leading end of the metal strip passes through the first wrapper apron. However, the present invention is not limited only to this configuration. For instance, the present invention may adopt a configuration to provide a control device, which controls drive of the fluid supply device in such a way as to stop the supply of the fluid when the passage of the leading end of the metal strip through a point between the first wrapper apron and the second wrapper apron is checked by using an optical sensor or the like. This configuration makes it possible to reduce the energy consumption by the fluid supply device as well as consumption of the fluid.

EXPLANATION OF REFERENCE NUMERALS

[0043]

1	coiler device
2	metal strip
20	mandrel
21	wrapper roller
22	wrapper apron
22A	wrapper apron
22a	guide surface
70	fluid supply device
72	fluid supply port
72A	first fluid supply port
72B	second fluid supply port

Claims

1. A coiler device provided with wrapper aprons, **characterized by:**

a mandrel configured to wind up a metal strip; a plurality of wrapper rollers configured to wrap the metal strip around the mandrel; and a plurality of wrapper aprons configured to guide a leading end of the metal strip in spaces between the adjacent wrapper rollers, and in that the coiler device includes a fluid supply device configured to supply a fluid to a guide surface of the wrapper apron disposed on the most upstream side from the viewpoint of winding the metal strip.

2. The coiler device provided with wrapper aprons according to claim 1, **characterized in that** the fluid supply device includes a fluid supply port formed in the guide surface.

3. The coiler device provided with wrapper aprons according to claim 2, **characterized in that** the fluid supply port is formed on an upstream side, from the viewpoint of winding the metal strip, of a position where the leading end of the metal strip first comes into contact with the guide surface.

4. The coiler device provided with wrapper aprons according to claim 3, **characterized in that** the fluid supply port is directed to a downstream side from the viewpoint of winding the metal strip.

5. The coiler device provided with wrapper aprons according to any one of claims 1 to 4, **characterized in that** the fluid supply device is configured to supply the fluid indirectly to the guide surface by spraying the fluid to the metal strip.

6. The coiler device provided with wrapper aprons according to claim 5, **characterized in that** the fluid supply device includes: first fluid supply ports configured to supply the fluid directly to the guide surface; and second fluid supply ports configured to supply the fluid indirectly to the guide surface by spraying the fluid to the metal strip, and the first fluid supply ports and the second fluid supply ports are formed in a staggered configuration in the guide surface.

FIG. 1

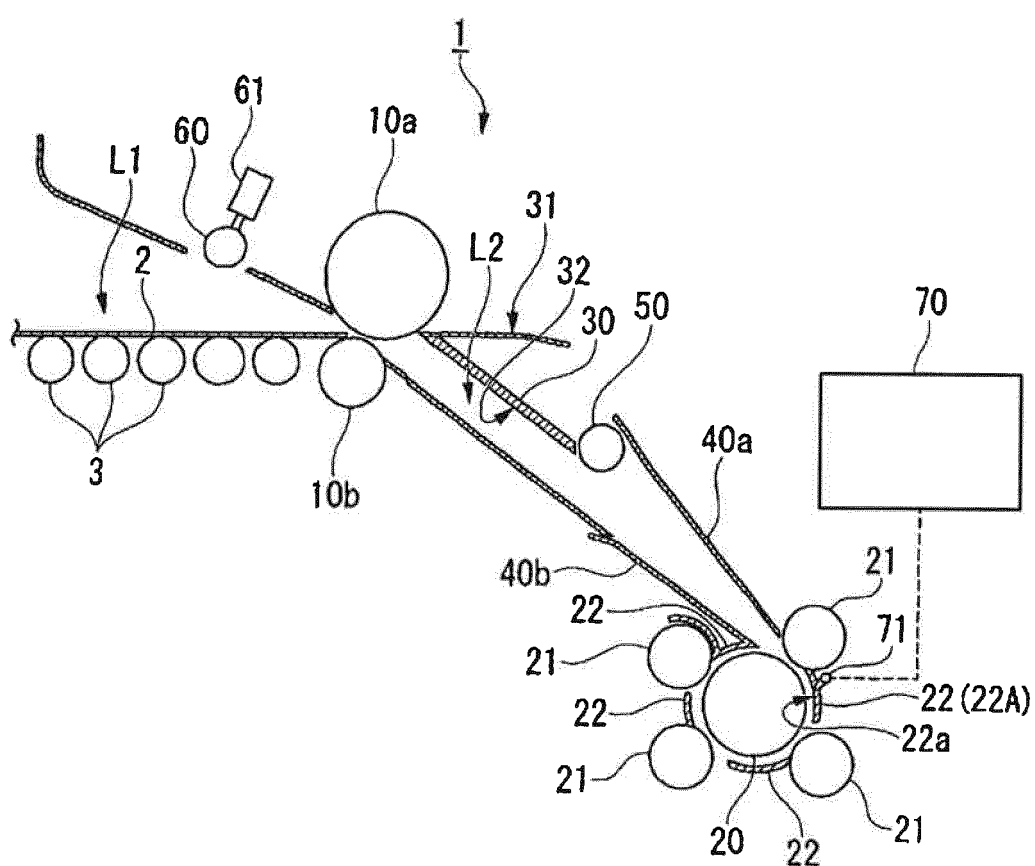


FIG.2

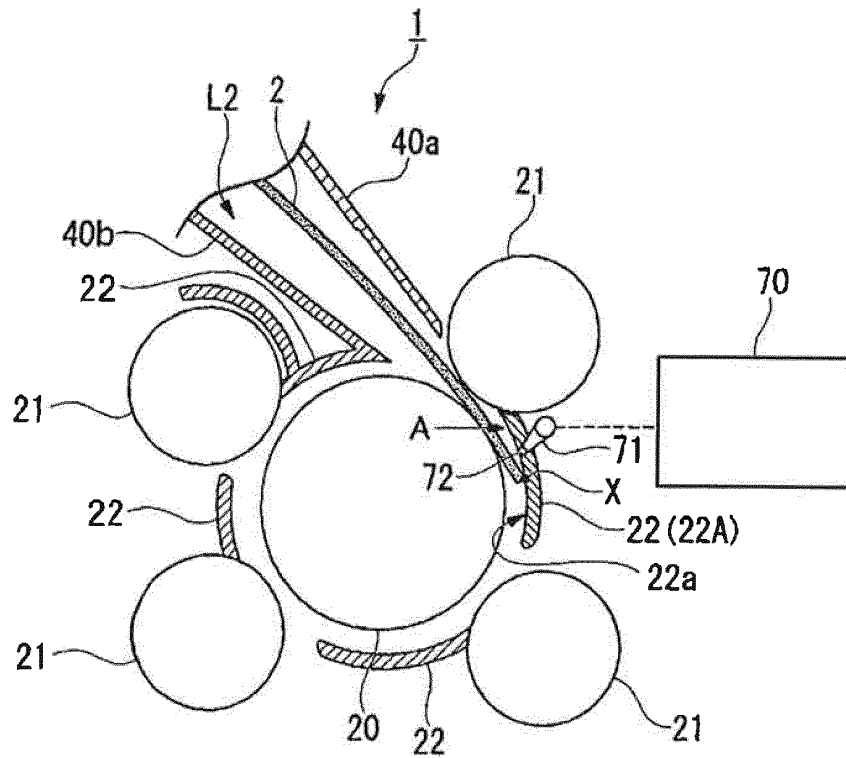


FIG.3

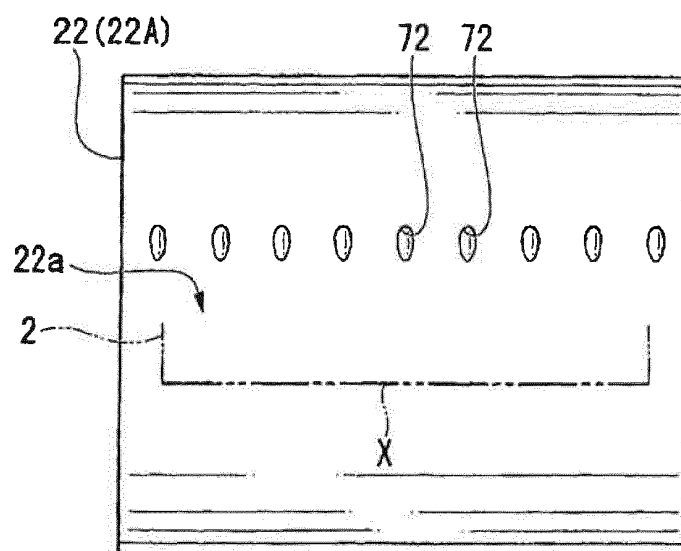


FIG.4

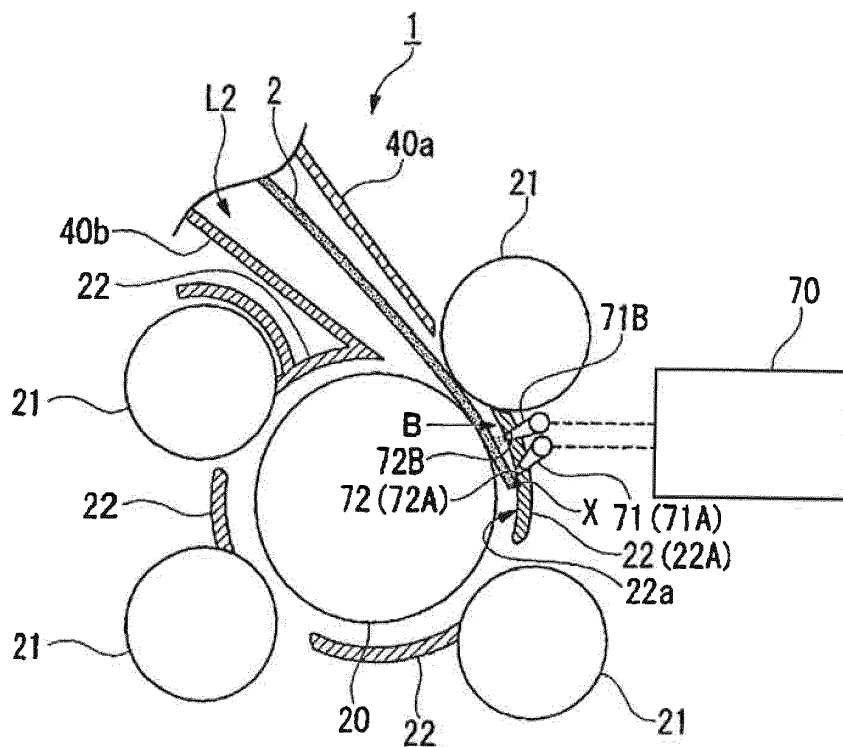
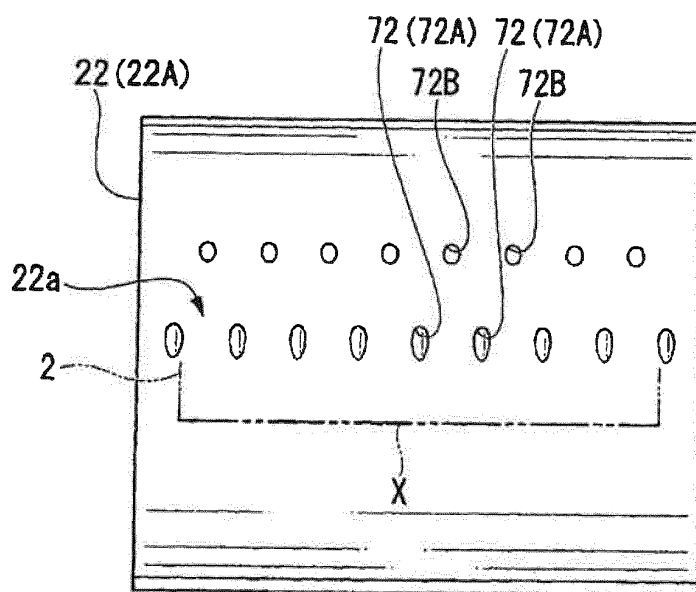


FIG.5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/057975

A. CLASSIFICATION OF SUBJECT MATTER

B21C47/06(2006.01)i, B21C47/34(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B21C47/06, B21C47/34

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015

Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X <u>Y</u>	JP 58-215220 A (Kawasaki Steel Corp.), 14 December 1983 (14.12.1983), page 2, lower left column, line 18 to page 3, upper right column, line 11; fig. 2 to 7 (Family: none)	1-3, 5-6 <u>4-6</u>
Y	JP 4-84621 A (Kawasaki Steel Corp.), 17 March 1992 (17.03.1992), page 2, lower left column, line 6 to page 3, upper right column, the last line; fig. 1 to 3 (Family: none)	4-6

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

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Date of the actual completion of the international search
19 May 2015 (19.05.15)Date of mailing of the international search report
02 June 2015 (02.06.15)Name and mailing address of the ISA/
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Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/057975

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 53-60354 A (Ishikawajima-Harima Heavy Industries Co., Ltd.), 30 May 1978 (30.05.1978), page 2, upper left column, line 12 to page 3, lower right column, line 2; fig. 2 (Family: none)	1-6
A	JP 62-248511 A (Nippon Steel Corp.), 29 October 1987 (29.10.1987), page 3, lower left column, line 9 to page 4, upper left column, line 4; fig. 1 to 2 (Family: none)	1-6

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2005305452 A [0004]