(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 166 249 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
19.04.2023 Bulletin 2023/16

(21) Application number: **21202186.9**

(22) Date of filing: **12.10.2021**

(51) International Patent Classification (IPC):
B21C 47/26 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B21C 47/262

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Sund Birsta AB**
85125 Sundsvall (SE)

(72) Inventor: **NILSSON, Lennart**
Gnarp (SE)

(74) Representative: **Bjerkén Hynell KB**
Tulegatan 53
113 53 Stockholm (SE)

(54) WIRE-HANDLING MACHINE

(57) A wire-handling machine (2) for receiving a series of preformed loops of wire (4) and for accumulating said loops of wire in order to form an upright coil of wire, comprising an essentially horizontal conveyor arrangement (6) to convey a rolled wire arranged in the form of overlapping loops of wire from a wire providing member (8) to at least one upwardly open wire-handling chamber (10). The conveyor arrangement (6) comprises a first conveyor part (12), a second conveyor part (14), and a third conveyor part (16).

The control unit (18) is configured to initiate and perform a wire cutting procedure comprising to:
-stop movement of conveyor on the second conveyor part (18) such that the loops of wire (4) is stationary in relation to the second conveyor part (18), and start moving the second conveyor part (18) in a direction against a second position P2 by a velocity corresponding to a second velocity;
-during movement of the second conveyor part (14) and when the loops of wire are stationary in relation to the second conveyor part (14), perform wire cutting of the wire at the forward end (20) of the second conveyor part (14) by a cutting device (22), and then
-move the second conveyor part (14) in a direction against a first position P1 and control the velocity of the conveyor of the second conveyor part (14) such that the loops of wire (4) are moved by essentially the same velocity as on the first and third conveyor parts (12, 16).

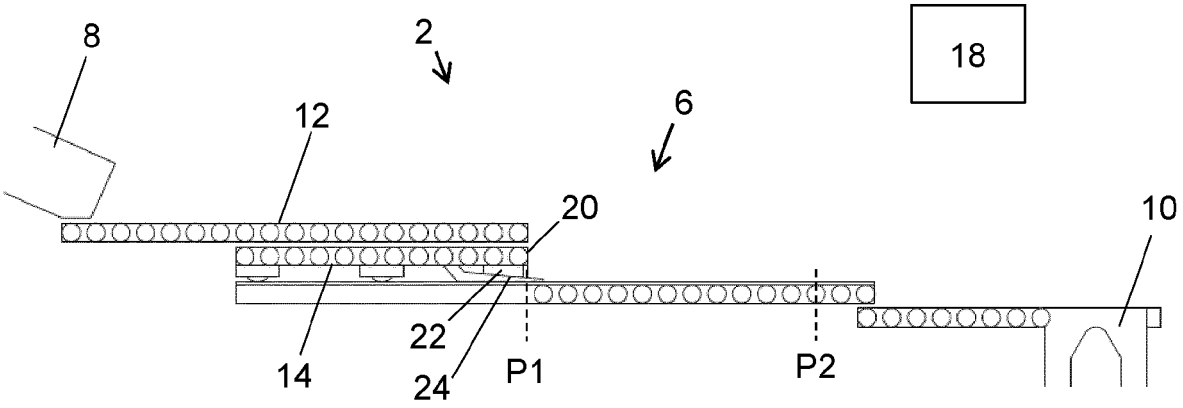

FIG. 1

EP 4 166 249 A1

Description

Technical field and background

[0001] The present invention relates to a wire-handling machine according to the preamble of claim 1 for receiving a series of preformed loops of wire and for accumulating said loops of wire in order to form a coil of wire.

[0002] In this description and the subsequent claims, the term "wire" encompasses metallic wires of thinner type as well as metallic wire rods.

[0003] Metallic wire produced in a rolling mill is normally accumulated in coils of essentially cylindrical configuration in a wire-handling machine, whereupon the coils can be compacted and bound in order to facilitate subsequent storing and transportation of the coils. It is a common practice to deliver the rolled wire to the wire-handling machine with the rolled wire arranged in the form of overlapping loops laying on an essentially horizontal conveyor, wherein the loops of wire at the end of the conveyor are allowed to fall vertically downwards from the conveyor into an upwardly open wire-handling chamber, herein also denoted coil collection station, provided in the wire-handling machine.

[0004] The diameter of the wire is normally in the range of 5.5 mm - 26 mm. The width of the conveyor is typically 1500 mm, and the loops of wire has a typical diameter of approximately 1000 mm.

[0005] The wire is rolled, based on a continuous casting process or by heating and rolling prepared billets. A billet is a prepared section of metal that can be reheated and rolled into e.g. a wire. To achieve continuous wire rolling based on prepared billets, individual billets are welded together before they are rolled. During rolling the wire is fed forward in its longitudinal direction at speeds up to 150 m/s through a series of rollers to a ring forming device, herein also denoted a laying head, with the shape of a drum. The wire may have a temperature of 1000 degrees or more as it exits the laying head. The laying head forms and lays the wire in partially overlapping rings on a transport path embodied by means a conveyor arrangement, which forms a cooling section, on which the wire rings are fed forward in the direction of a coil collecting station where the wire is collected into a coil. The conveyor cooling section controls the cooling rate in order to achieve the desired metallurgical properties of the wire by using different conveyor speeds, hoods and fans.

[0006] The horizontal conveyor arrangement between the laying head and the collection station is provided with transport elements, e.g. in the form of driven rollers or driven endless chains on which the wire rings rests and are fed. The transport elements are conventionally driven by one or many driving members. The velocity of the rings of wire moved by the conveyor arrangement is normally in the range of 0,1-1 m/s.

[0007] Conventionally, during continuous rolling, the wire is cut either before the inlet to the laying head or in the coil collection station.

[0008] When cutting takes place before the inlet to the laying head, the resulting front and back end of the coil receives different metallurgical properties than rest of the wire, which means that they have to be discarded. This disposal is currently done by manual end trimming in a trimming station after the coil collecting station, which e.g. requires two people per work shift and which is therefore expensive. In addition, the end trimming is a tiring job in harsh conditions (high heat due to hot wire means that protective clothing must be used and in addition use of heavy hydraulic scissors which entails heavy lifting and non-ergonomic working conditions).

[0009] When cutting takes place in the coil collection station itself the wire is cut below a cone in the wire-handling chamber. The coil can be cut by stretching the upper and lower part of the coil in different directions to enable separation of a single ring lap and then move one or several scissors horizontally into the coil. However, the amount of force and travel needed to effectively separate a single ring lap varies largely depending on the dimension, temperature, and metallurgical properties of the wire and so it is difficult to find all suitable parameters. The coil can also be cut by forcing several cutting discs horizontally into the coil from different directions, cutting the wire in one or several places depending on the separation and distribution of the wires. This gives no control over where the cut takes place and also entails the possible formation of smaller pieces of wire that risk getting stuck in the pallet conveyor system, causing production stops.

[0010] DE-4109201 shows a solution where the conveyor track comprises two horizontal and mutually overlapping belt parts in the form of an initial upper belt and a terminating lower belt. The upper belt part is horizontally movable and when cutting of wire is to be performed on the lower belt part or in a wire collecting shaft downstream of the lower belt part, the upper belt part is moved backwards relative to the lower belt part at the same time wire loops on the lower belt section are stopped or made at a reduced speed.

[0011] US-3260471 shows a transport path for advancing wire loops with three horizontal and mutually overlapping belt sections, where a middle conveyor is horizontally movable relative to an initial upper conveyor and a terminating lower conveyor. The horizontal position of the middle conveyor is manually adjustable to regulate the effective feed distance on the lower conveyor.

[0012] The object of the present invention is to achieve an improved wire-handling machine for separating and dividing the wire into coils. More particularly, to achieve wire-handling by making it possible to separate a single ring lap, control where the wire is cut on that ring lap, making the cut without affecting the metallurgical properties of the wire and finally to separate the back end of the cut coil from the front end of the coming coil.

Summary

[0013] The above-mentioned object is achieved by the present invention according to the independent claim.

[0014] Preferred embodiments are set forth in the dependent claims.

[0015] The present invention relates to a wire-handling machine for separating and dividing wire rings on a horizontal transport path, during cooling of the wire, between a wire providing member (laying head) and a vertical wire-handling chamber, in order to be able to cut the wire to desired lengths during wire rolling. This machine can be used during both continuous and non-continuous rolling.

[0016] On the transport path, the wire is fed lying in partially overlapping loops. In order to be able to cut at the desired places, the wire loops need to be vertically separated from each other. After cutting, the wire loops downstream of the cutting point are preferably advanced at a higher speed than the wire loops upstream of the cutting point to provide a gap between consecutive wire sections.

[0017] Thus, a wire-handling machine is provided for cutting loops of wire on the conveyor track with three horizontal and mutually overlapping belt parts, a first, second, and third conveyor part, where the second conveyor part is horizontally movable in the feed direction relative to the upstream first conveyor part and the downstream third conveyor part in order to provide a hanging and relatively stationary wire loop at the front end of the second conveyor part and thereby enable cutting on a "stationary" wire loop at the same time as wire loops can be advanced in an unchanged manner on the first and third conveyor parts. Within the scope of protection as defined by the patent claims, one or many additional conveyor parts may be provided, in addition to the first, second, and third conveyor parts.

[0018] By the wire-handling machine according to the present invention controlled separation and dividing of coils is achieved during wire rolling without affecting the metallurgical properties of the wire at the front and back end of the coil. This is advantageous as less loops of wire need to be discarded and it will increase the overall output as well as the production capacity. Furthermore, the dividing and separation procedure provided herein is completely automatic which also improves workplace safety and lowers operating costs.

[0019] More particularly, the horizontal transport distance between the laying head and the wire-handling chamber is divided into three different parts, a first conveyor part, which constitutes a cooling part, a second conveyor part that is movable in the horizontal direction and a third conveyor part. Each part is provided with transport elements in the form of driven rollers or driven endless chains on which the wire rings rest and are fed.

[0020] During normal feeding, the second conveyor part is in a retracted position with its front end just downstream of the front end of the first conveyor part and the transport elements of all parts are preferably driven at essentially the same velocity. From the front end of the first conveyor part, the wire rings are dropped down on the second conveyor part and from the front end of the second conveyor part, the wire rings are dropped down on the third conveyor part.

When the wire is to be cut, the drive of the transport elements of the second conveyor part is stopped and the second conveyor part is instead moved horizontally forward relative to the first and third conveyor parts at a velocity corresponding to the feed velocity so that the wire rings at the front end of the second conveyor part will be stationary in the horizontal direction in relation to the second conveyor part. During this forward movement of the second conveyor part, the cutting takes place in the space between the front end of the second conveyor part and the third conveyor part.

When the cutting has been carried out, the transport elements of the third conveyor part are preferably accelerated so that a gap is created between the wire portion downstream of the cutting site and the wire portion upstream of the cutting site. After cutting, the second conveyor part is moved back to the initial position. During this movement, the transport elements of the second conveyor part must be driven at a higher speed than the transport elements of the first and third conveyor parts (if the return is by the same velocity as the feed velocity, the transport elements of the second conveyor part must be driven by twice the feed velocity) so that a continuous and even feed of the wire rings can take place.

[0021] The cutting should preferably take place at the rear edge of a wire loop in order to avoid the cut wire end becoming entangled in the front wire rings during the continued feed towards the collection station, and to ensure that the wire rings are safely received by the collection station. However, the cutting could alternatively take place elsewhere on the wire ring.

[0022] According to one embodiment, the cutting device comprises a horizontal (preferably slightly angled) separation plate which is placed below the front end of the second conveyor part and which is attached to the second conveyor part for movement together therewith. One or more wire loops accumulate on this plate and when cutting is to be performed, a lifting hook is moved forwards and upwards through a recess in the plate to grasp the wire rings on the plate. The separation plate is then lifted together with the hook so that a vertically elongated and helical wire turn occurs between the underside of the plate and the upper side of the third conveyor part, after which a disc-shaped member is pivoted on the underside of the plate towards this wire turn, and for the wire to abut a fixed edge on the underside, a movable edge is pushed forward against the fixed edge to cut the wire. When the cutting is complete, the plate and hook are moved down towards the third conveyor part and the lifting hook is then returned to the initial position.

This embodiment is advantageous in that it is assured that a stationary helical wire turn is provided by means of the separation plate and the lifting hook which facili-

tates that an accurate cutting of the wire may be achieved.

Brief description of the drawings

[0023]

Figure 1 is a schematic side view of the wire-handling machine according to the present invention.

Figure 2 is a schematic view from above of the wire-handling machine according to the present invention.

Figures 3-11 show schematic side views of the wire-handling machine illustrating various aspect of different embodiments.

Figures 12-17 show simplified and perspective views of the wire-handling machine illustrating various aspect of different embodiments.

Detailed description

[0024] The wire-handling machine 2 will now be described in detail with references to the appended figures. Throughout the figures the same, or similar, items have the same reference signs. Moreover, the items and the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention.

[0025] With references to figures 1 and 2, a wire-handling machine 2 for receiving a series of preformed loops of wire 4 (see figures 3-11) is provided, for accumulating the loops of wire in order to form a coil of wire, e.g. an upright coil of wire. The wire-handling machine comprises an essentially horizontal conveyor arrangement 6 comprising conveyors configured to convey a rolled wire arranged in the form of overlapping loops of wire from a wire providing member 8 to at least one upwardly open wire-handling chamber 10 provided in the wire-handling machine. The wire-handling chamber 10 may be an upwardly open wire-handling chamber.

[0026] The conveyor arrangement 6 comprises a first conveyor part 12 configured to move the loops of wire 4 by a first velocity, a second conveyor part 14 configured to move the loops of wire by a second velocity, and a third conveyor part 16 configured to move the loops of wire by a third velocity. In the example illustrated by the figures, the third conveyor part 16 is in its turn divided into two conveyor parts. During normal operation, said velocities are essentially the same.

[0027] The first conveyor part 12 is arranged at higher vertical level than the second conveyor part 14, and the second conveyor part 14 is arranged at a higher vertical level than the third conveyor part 16.

[0028] The wire-handling machine 2 comprises a control unit 18 configured to control the velocities of the first, second, third conveyor parts.

[0029] The control unit comprises the necessary processing, communication and storing capabilities to provide and submit control signals configured to control the operation of the wire-handling machine. In particular, the control unit is configured to control various driving members to provide driving movements to the conveyors of the conveyor arrangement, e.g. to control the velocities of the conveyors.

[0030] The second conveyor part 14 is movable along its longitudinal extension in relation to the first and third conveyor parts 12, 16 between a first position P1 and a second position P2, wherein in the first position P1 a forward end 20 of the second conveyor part 14 is upstream compared to when the forward end is in the second position P2.

[0031] The control unit 18 is further configured to control the forward and backward movement of the second conveyor part 14 along its longitudinal extension in relation to the first and third conveyor parts 12, 16.

[0032] When the wire-handling machine operates according to normal operation, the control unit 18 is configured to initiate and perform a wire cutting procedure.

[0033] The various procedural steps of the wire cutting procedure will now be described in detail with references to figures 3-11.

In the figures, movements of conveyor rolls, i.e. rotations, of the conveyor arrangement are schematically illustrated by circled arrows, where one arrow indicates one velocity and two arrows indicate another higher velocity. Horizontal arrows indicate horizontal movement.

[0034] Normal operation is illustrated in figure 3. The loops of wire moves along the conveyor arrangement from the wire providing member 8, to the wire-handling chamber 10 by the same velocity. In the illustrated example, the second conveyor part 14 is arranged in its upstream position where it is completely withdrawn under the first conveyor part 12.

[0035] The wire cutting procedure comprises to:

Stop movement of rollers or chains on the second conveyor part 14 such that the loops of wire 4 are stationary in relation to the second conveyor part 14, and start moving the second conveyor part 14 in a direction against the second position P2 by a velocity corresponding to the velocity of the chains or rollers on the first and third conveyor parts 12, 16. The movement of the second conveyor part 14 is indicated by horizontal arrows. This is shown in figure 4.

[0036] By moving the second conveyor part 14 with a velocity corresponding to the velocities of the chains or rollers of the first and third conveyor parts 12, 16 the loops of wire are stationary in relation to the second conveyor part 14 (which is shown in figure 5 by having no circular arrows in the rollers), it is therefore possible to perform wire cutting at the forward end 20 of the second conveyor part 14 by a cutting device 22. The cutting is schematically illustrated by the pair of scissors shown in figure 5.

Figure 6 shows the next step, where the loops of wire downstream from the cutting point continue to move on the chains or rollers on the third conveyor part 16. In this

example the velocity of the wire loops on the third conveyor part 16 is increased (indicated by double arrows in the rollers) to create a distance to the loops of wire upstream from the cutting point. In figure 7 this distance have been successfully created and the loops of wire downstream from the cutting point have reached the wire-handling member 10.

[0037] In the following step, shown in figures 8 and 9, the velocity of the rollers or chains of the third conveyor part 16 are the same as the velocity of the rollers or chains of first conveyor part 12 (see figure 8), and the cutting device 22 releases the loops of wire. In addition, the rollers or chains of the second conveyor part 14 is set to the same velocity as on the first and third conveyor parts 12, 16. The forward movement of the second conveyor part 14 has been stopped.

[0038] In the next step, shown in figure 10, the second conveyor part 14 is moved back in a direction against the first position P1. The velocity of the rollers or chains on the second conveyor part 14 is controlled such that the loops of wire 4 are moved by the same velocity as on the first and third conveyor parts 12, 16. If, as an example, the velocity of the second conveyor part 14 in the direction against the first position P1 is the same as the velocity of the loops of wire on the first and third conveyor parts 12, 16, the velocity of the loops of wire on the second conveyor part 14, in relation to the second conveyor part 14 (i.e. not in relation to ground), must then be twice as high. Finally, in figure 11, is shown the situation during normal operation.

[0039] It should be noted that all velocities and movements are in relation to ground where the wire-handling machine 2 is arranged.

[0040] During normal operation, the forward end 20 of the second conveyor part 14 is in the first position PI.

[0041] According to one embodiment, the control unit 18 is configured to control the third velocity, i.e. the velocity of wire loops on the third conveyor part 16, such that the wire loops downstream of the cutting point are advanced at a higher speed than the wire loops upstream of the cutting point to provide a gap between consecutive wire sections. Preferably, the increased third velocity is 10-30% higher than the first velocity. In a further embodiment, the third velocity is increased during a predetermined time interval, which is related to how big gap between consecutive wire sections that is required, but is typically in the range of 4-8 seconds.

[0042] In one embodiment, the cutting device 22 comprises two movable cutting edges (e.g. horizontally movable) to be pressed against the wire from opposite directions with high pressure and thereby providing a cut of the wire.

[0043] According to another embodiment, the control unit 18 is configured, during the wire cutting procedure, to control vertical movement of the forward end 20 of the second conveyor part 14 a predetermined distance in an upward direction to enable the cutting device 22 to cut the wire by separating out one loop of wire where the cutting may be performed. When the wire has been cut, the control unit is configured to control vertical movement of the forward end 20 of the second conveyor part 14 the predetermined distance in a downward direction.

[0044] According to another embodiment, the cutting device 22 comprises a separation plate 24 configured to be inserted between loops of wire during the wire cutting procedure to separate loops of wire to enable wire cutting. The separation plate 24 is shown in figures 1-3. In still another embodiment, the cutting device 22 comprises at least one wire holding member 26 configured to hold the wire during the wire separation and cutting procedure. The wire holding member is shown in figures 12-17.

[0045] One particular embodiment of the wire cutting device 22 will now be described with references to figures 12-17, but also with references to the procedure shown in figures 3-11.

[0046] Figures 12 and 13 show details of the cutting device comprising the separation plate 24 and the wire holding member 26, which in this embodiment comprises two lifting arms. The separation plate may be individually controlled, e.g. by a separate control lever, to move backwards and forwards in relation the second conveyor part 14, and may also be raised, lowered, and slightly angled. Just before stopping the conveyors, the separation plate 24 is inserted at the same velocity as the rollers or chains on the third conveyor part 16 (see also figures 3 and 4). Thus, the separation plate is slid into the back end of the ring laps (i.e. the loops of wire) at the same velocity as they are moving on the conveyor. When the separation plate is slid approximately 100mm into the ring laps, the rollers or chains on the second conveyor part 14 stop and at the same time the entire second conveyor part 14 starts moving at the same velocity as the ring laps (see figure 4). Thus, the separation plate 24 follows third velocity of the third conveyor part 16.

[0047] The separation plate then lifts the ring laps, which has fallen onto it, to create a gap and prepare for separation of the upper and lower part of the wire ring. The lifting arms then moves upward to prevent the ring laps from moving, and the separation plate moves forward and separates the upper part of the ring from lower part of the ring. The hooks on the lifting arms prevents the ring laps from moving forward along with the separation plate. This is illustrated in figure 14.

[0048] A wire former (not shown) shapes and guides the wire to the wire cutters. The circular shaped wire former rotates to guide the single ring lap (which is connecting the upper part of the ring to the lower part of the ring being separated by the separation plate) into the cutting edges, and the wire is then cut off by the cutting edges. See figure 15, and figure 5.

[0049] The downstream loops of wire can then be fed forward, as the lower part of the ring is free from the upper part of the ring, which rests on the separation plate. The velocity of the third conveyor part 16 may then be increased to create a gap, see figure 16.

The separation plate is retracted and the upper conveyor

is lowered, which is illustrated by figure 17, and figure 8. When the separation plate is retracted, the lifting arm stays in position to keep the ring laps from sliding backwards along with the separation plate.

[0050] And finally, the lifting arms are lowered to release the upper part of the ring laps onto the rollers or chains of third conveyor part 16. The second conveyor part 14 stops moving and the rollers or chains on the second conveyor part 14 starts to move again.

[0051] The present invention is not limited to the above-described preferred embodiments. Various alternatives, modifications and equivalents may be used. Therefore, the above embodiments should not be taken as limiting the scope of the invention, which is defined by the appending claims.

Claims

1. A wire-handling machine (2) for receiving a series of pre-formed loops of wire (4) and for accumulating said loops of wire in order to form a coil of wire, comprising an essentially horizontal conveyor arrangement (6) comprising conveyors configured to convey a rolled wire arranged in the form of overlapping loops of wire from a wire providing member (8) to at least one wire-handling chamber (10) provided in the wire-handling machine,

the conveyor arrangement (6) comprises a first conveyor part (12) configured to move said loops of wire (4) by a first velocity, a second conveyor part (14) configured to move said loops of wire by a second velocity, and a third conveyor part (16) configured to move said loops of wire by a third velocity, the first conveyor part (12) is arranged at a higher level than the second conveyor part (14), and the second conveyor part (14) is arranged at a higher level than the third conveyor part (16), wherein during normal operation, said velocities are the same,

characterized in that said wire-handling machine (2) comprises a control unit (18) configured to control the velocities of the first, second, third conveyor parts, and that said second conveyor part (14) is movable along its longitudinal extension in relation to the first and third conveyor parts (12, 16) between a first position P1 and a second position P2, wherein in the first position P1 a forward end (20) of the second conveyor part (14) is upstream compared to when the forward end is in the second position P2, wherein the control unit (18) is configured to control the movement of the second conveyor part (14), and wherein, during normal operation, the control unit (18) is configured to initiate and perform a wire cutting procedure comprising to:

- stop movement of conveyor on the second conveyor part (14) such that the loops of wire (4) is stationary in relation to the second conveyor part (14), and start moving the second conveyor part (14) in a direction against the second position P2 by a velocity corresponding to the second velocity;
- during movement of the second conveyor part (14) by the second velocity and when the loops of wire are stationary in relation to the second conveyor part (14), perform wire cutting of the wire at the forward end (20) of the second conveyor part (14) by a cutting device (22) structured to cut the wire, and then
- move the second conveyor part (14) in a direction against the first position PI and control the velocity of the conveyor of the second conveyor part (14) such that the loops of wire (4) are moved by the same velocity as on the first and third conveyor parts (12, 16), wherein all velocities and movements are in relation to ground where the wire-handling machine (2) is arranged.

2. The wire-handling machine (2) according to claim 1, wherein during normal operation the forward end (20) of the second conveyor part is in its first position P1.

3. The wire-handling machine (2) according to claim 1 or 2, wherein the control unit (18) is configured, during the wire cutting procedure, to control vertical movement of the forward end (20) of the second conveyor part (14) a predetermined distance in an upward direction to enable the cutting device (22) to cut the wire, and to control vertical movement of the forward end (20) of the second conveyor part the predetermined distance in a downward direction when the wire is cut.

4. The wire-handling machine (2) according to any of claims 1-3, wherein the cutting device (22) comprises a separation plate (24) configured to be inserted between loops of wire during the wire cutting procedure to separate loops of wire to enable wire cutting.

5. The wire-handling machine (2) according to any of claims 1-4, wherein the cutting device (22) comprises at least wire holding member (26) configured to hold the wire during the wire cutting procedure.

6. The wire-handling machine (2) according to any of claims 1-5, wherein the cutting device (22) comprises two movable cutting edges arranged to cut the wire when moved against each other.

7. The wire-handling machine (2) according to any of

claims 1-6, wherein the control unit (18) is configured to control the third velocity such that the wire loops downstream of the cutting point are advanced at a higher speed than the wire loops upstream of the cutting point to provide a gap between consecutive wire sections.

8. The wire-handling machine (2) according to claim 7, wherein said third velocity is increased during a pre-determined time interval.

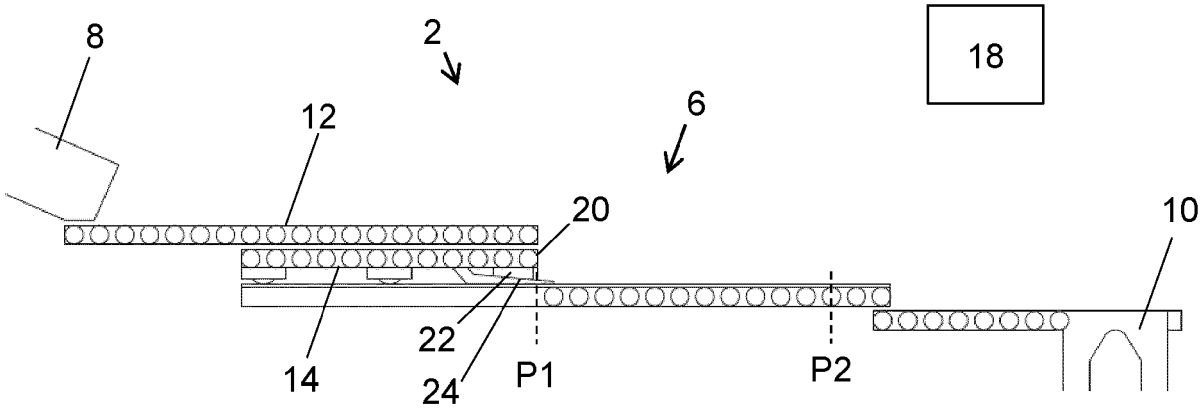

FIG. 1

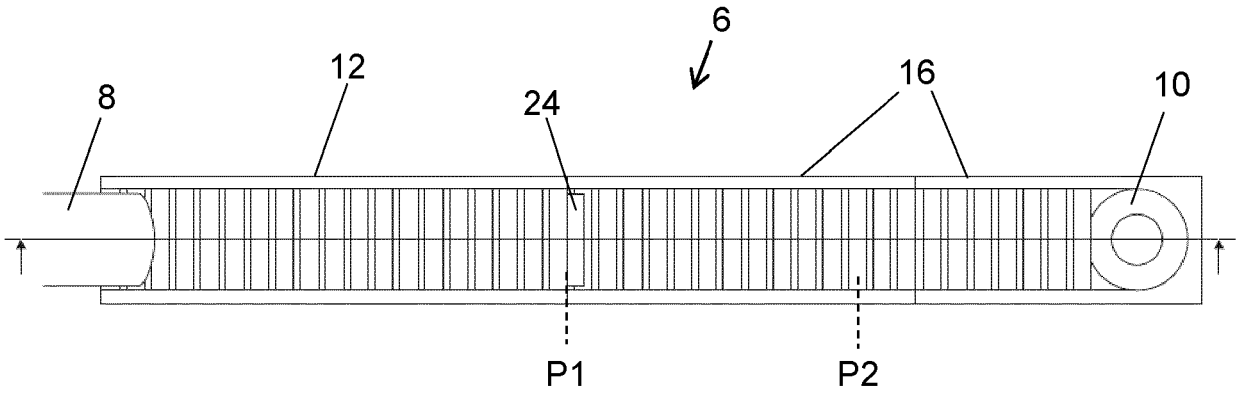

FIG. 2

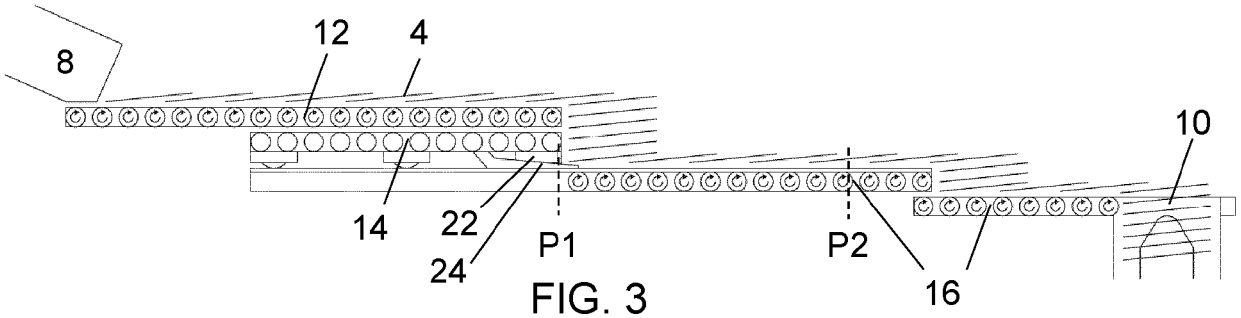

FIG. 3

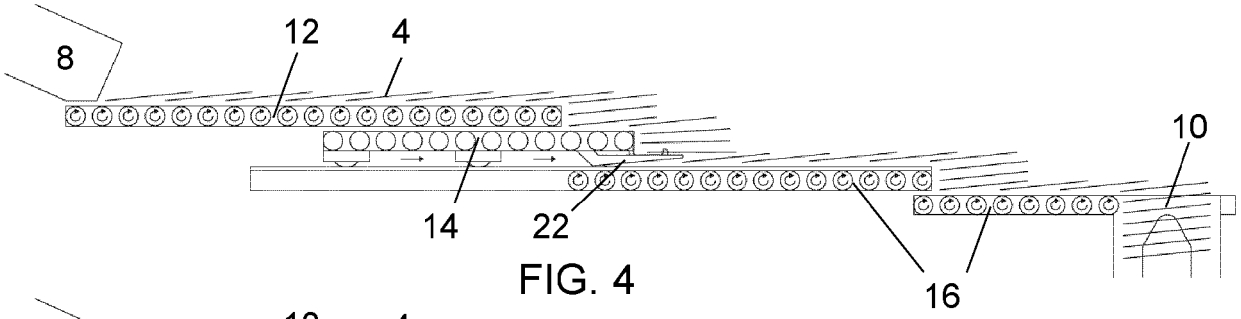

FIG. 4

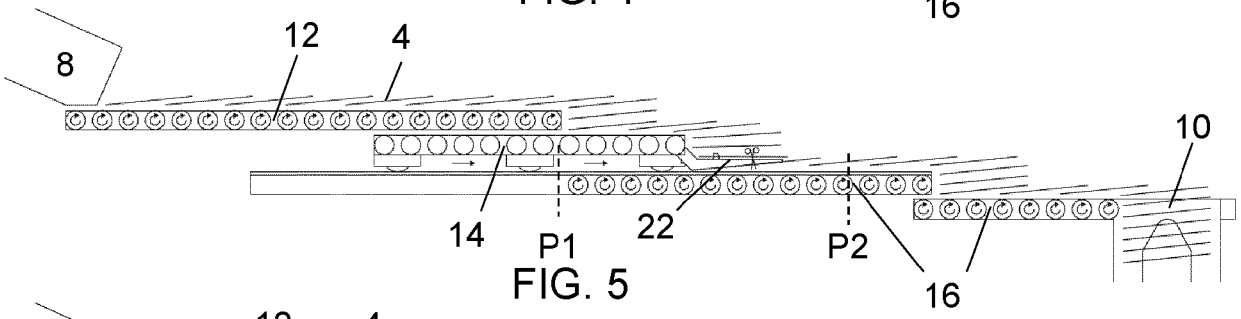

FIG. 5

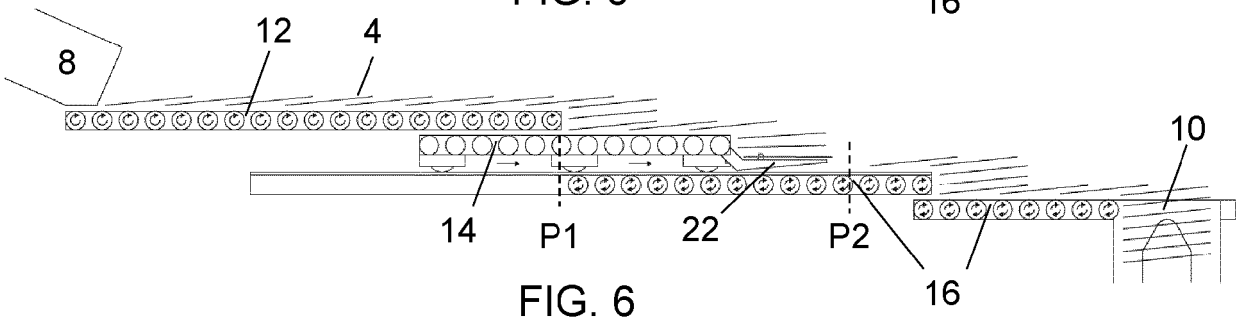

FIG. 6

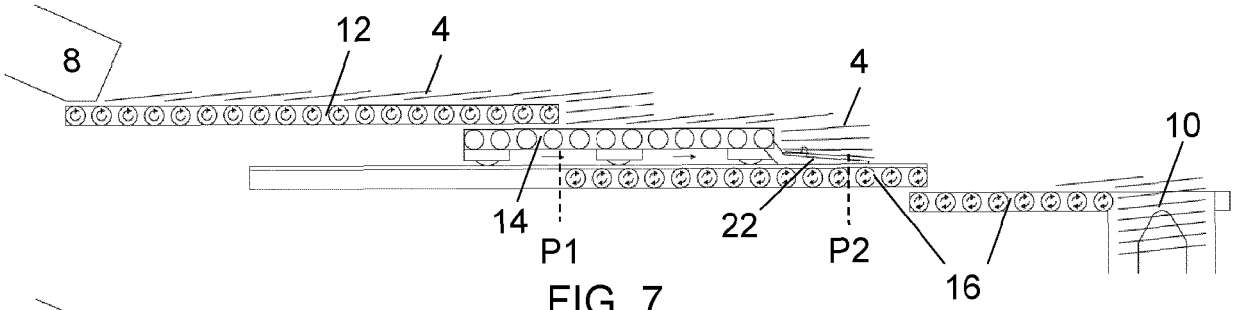

FIG. 7

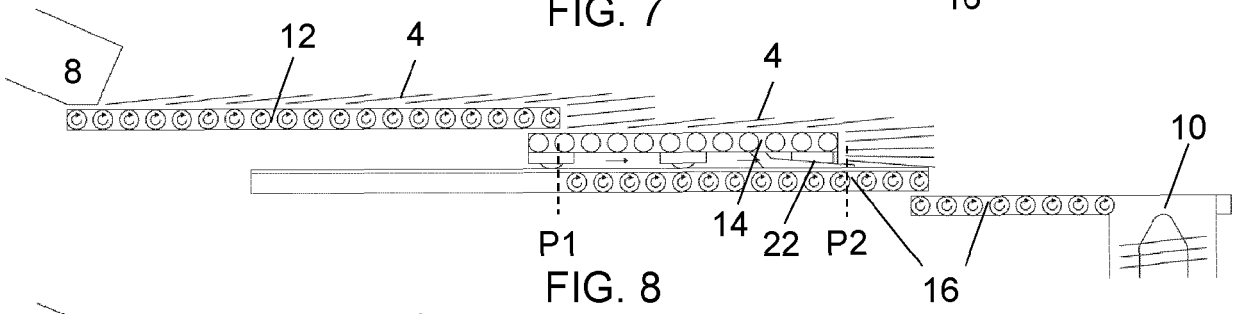

FIG. 8

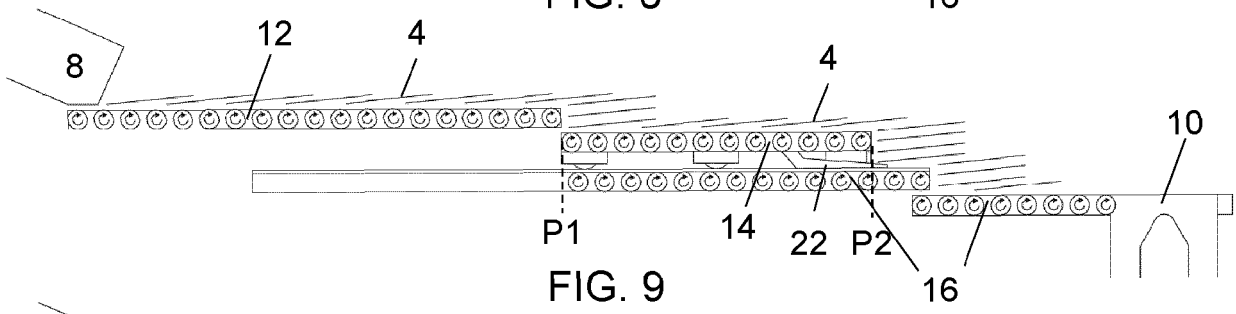

FIG. 9

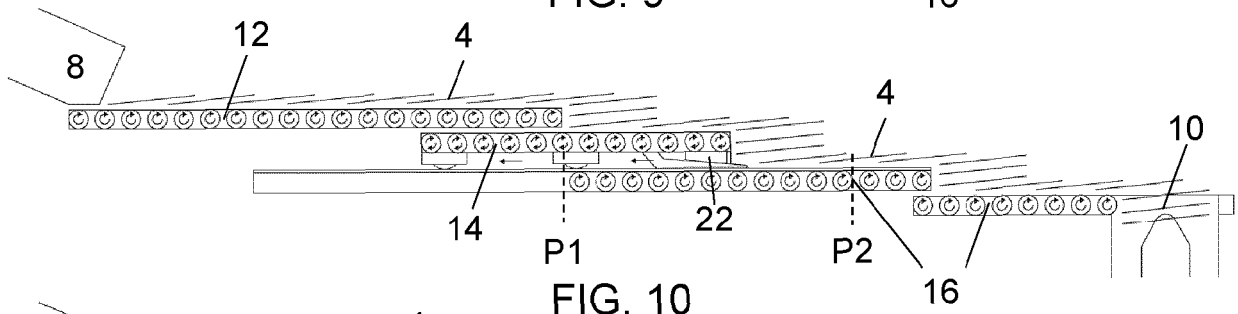

FIG. 10

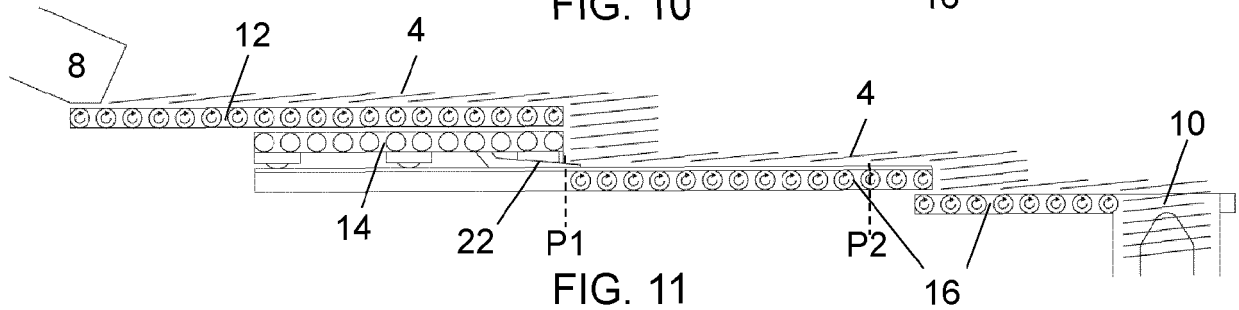

FIG. 11

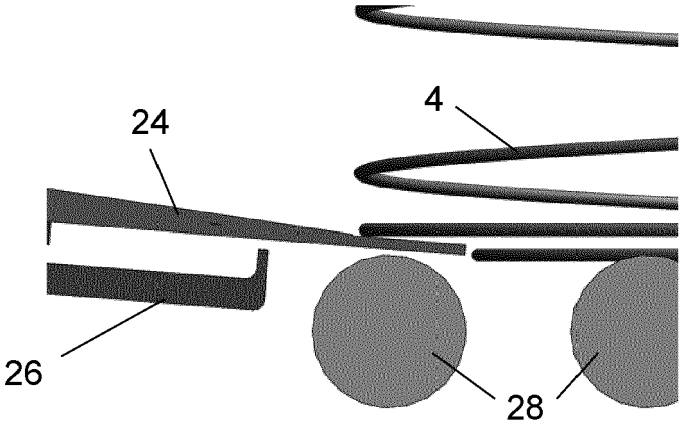

FIG. 12

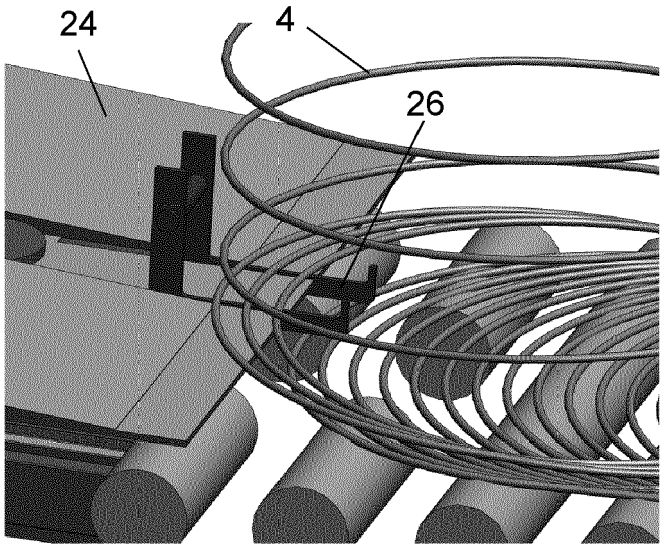

FIG. 13

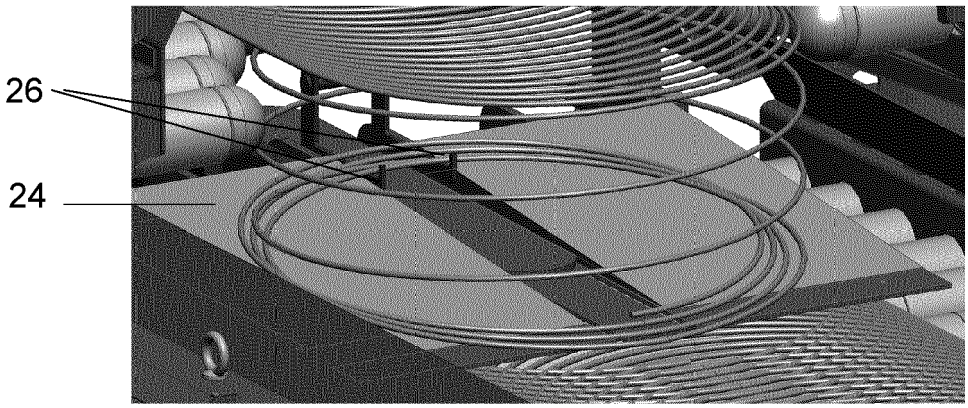

FIG. 14

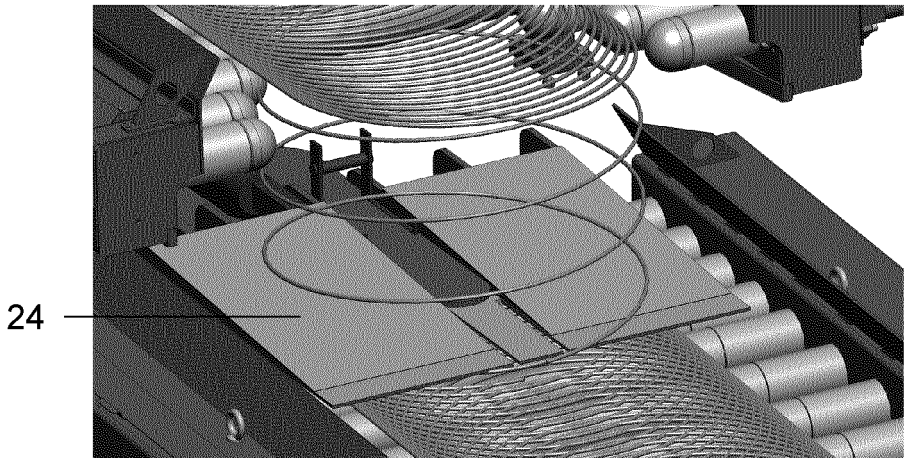

FIG. 15

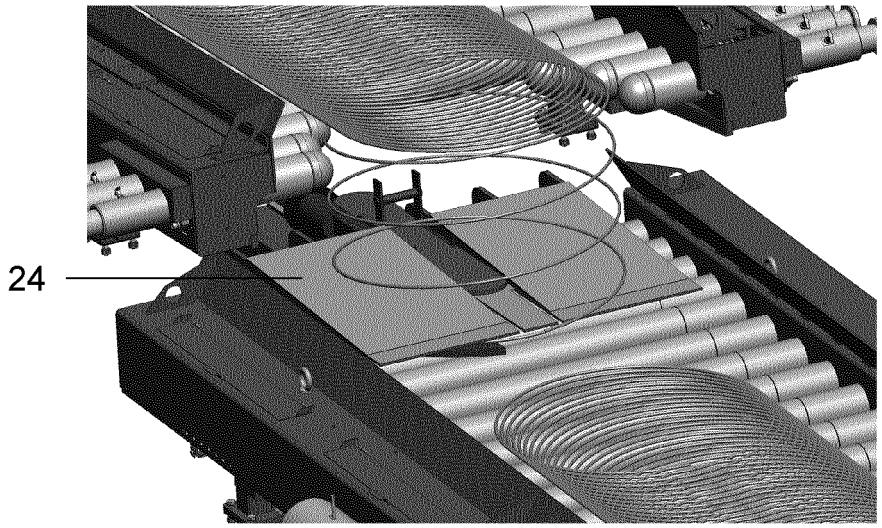

FIG. 16

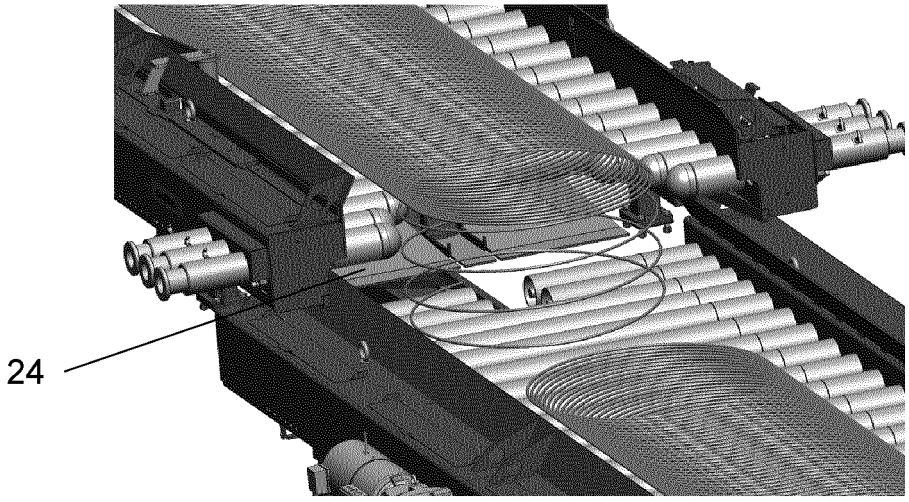

FIG. 17

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 21 20 2186

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	JP 2007 152354 A (KOBE STEEL LTD) 21 June 2007 (2007-06-21) * paragraphs [0026] - [0044]; figures 1-12 * -----	1-3,5-8 4	INV. B21C47/26
Y	DE 41 18 958 A1 (THAELMANN SCHWERMASCHBAU VEB [DE]) 10 December 1992 (1992-12-10) * column 3, line 63 - column 4, line 1; figure 5 * -----	4	

TECHNICAL FIELDS SEARCHED (IPC)

B21C
B21F
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 March 2022	Augé, Marc

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
.....
& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 21 20 2186

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

24-03-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2007152354 A	21-06-2007	JP 4369919 B2	25-11-2009
		JP 2007152354 A	21-06-2007
DE 4118958 A1	10-12-1992	NONE	

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 4109201 **[0010]**
- US 3260471 A **[0011]**