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(54) Horizontal strip accumulator with slim strip supporting carriages and passive central hooking system

(57) A horizontal strip accumulator installation (1) in a continuous strip processing line, comprising a looping carriage riding on a pair of external rails (5), with a plurality of strip supporting carriages (2), each comprising a vertical frame (3) disposed on two wheels (4) riding on the same external rails (5), characterised in that the vertical frame (3) is connected on each side of the strip to inclined brackets (8) provided with guiding cam rollers (12) riding in respective guiding profiles or girders (9) located under the rails (5), so as to guide the strip supporting carriage (2) on the external rails (5) in an anti-tilting-over manner. The system has an automatic central hooking and unhooking system for the distribution of the strip supporting carriages as well as a maintaining device at their dedicated locations.

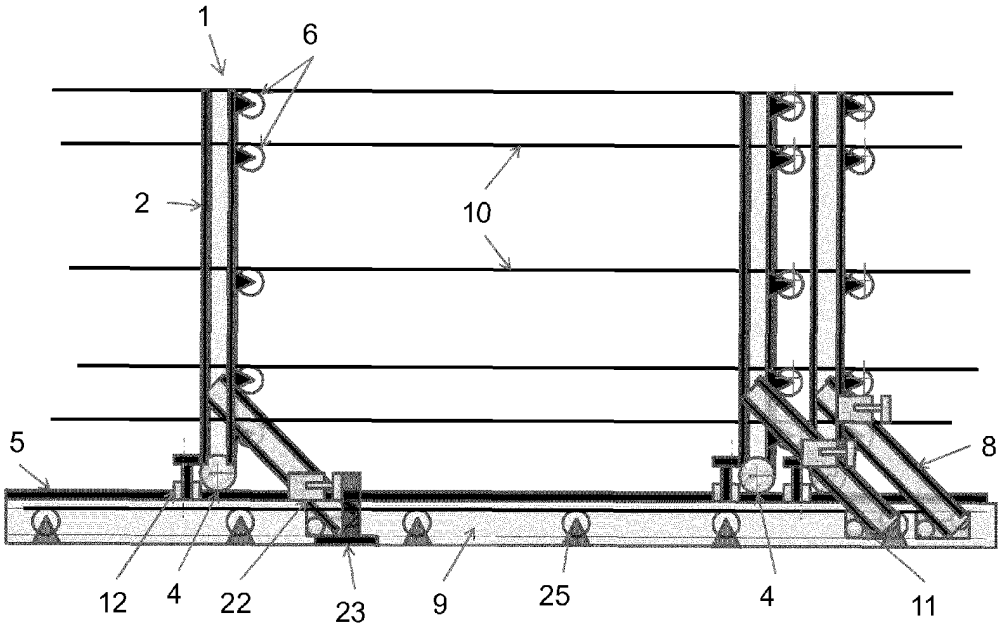

FIG. 1

EP 2 759 350 A1

Description

Field of the invention

[0001] The present invention pertains to the technical field of horizontal strip accumulators with strip supporting carriages, which can be erected on flat ground.

[0002] Additionally, the invention concerns strip supporting carriages with slim design and anti-tilting-over system, as well as passive, central hooking and unhooking system of the strip supporting carriages placed at dedicated locations with a maintaining system in these locations when unhooked.

[0003] The present invention is intended to be used in continuous strip processing lines such as pickling, continuous milling, PLTCM, continuous annealing, galvanizing, tin plating, color coating, anodizing, polishing, ... lines for the metal industry. There are also potential applications thereof in continuous processing lines for the production of plastic or fabrics.

Technological background and prior art

[0004] Horizontal strip accumulators with strip supporting carriages are more and more requested due to their reliability compared to accumulators with roll gates and to the fact that they do not affect the strip, even under adverse conditions.

[0005] Accumulators such as those used in the context of the present invention comprise several parts: on one side fixed rolls, which feed and recover the strip in the accumulator, on the other side an accumulator carriage driving on rails. The accumulator carriage generates the loops for strip accumulation. The forward direction is normally specified when the carriage enlarges the strip loops. The backwards movement happens while diminishing the loops. The force needed to enlarge the strip loops is typically transmitted by a winch, rope and pulley system attached to the accumulator carriage. The backwards movement is performed by the strip tension force, counterbalanced in consequence by the winch.

[0006] The strip accumulator carriage is followed by several strip supporting carriages, which shall limit the strip sag to avoid that strip strands rub on each other. The strip support carriages are hooked to the accumulator carriage and to each other, when the accumulator is at its minimum strip filling. These strip supporting carriages have to be distributed at a required inter-distance over the accumulator length to fulfill their desired function, when filling the accumulator with strip. The strip support carriages are collected by the looper carriage and hooked to it or to the support carriage already attached thereto, when the loop diminishes.

[0007] Typical designs of prior art use an accumulator carriage and a system to locate the strip supporting carriages in different manners:

- individual electric drives for each carriage needing a considerable amount of cable chains (EP 388708 A1), or an electric rail and tap or trolley arm (DE 10104093 A1), or a linear motor (DE 3925193 A1);
- a drive with rope (EP 110864 A1) or tooth belt (CN 1158765 A) to have always the same distance between the carriages, needing a very long rope/tooth belt and a special pulley/pinion system;
- a passive hooking and locking system with buffers for stopping the carriages, when they arrive in their respective dedicated locations (FR 2 698 803 A1).

[0008] Most of these systems use four-wheel support carriages to overcome the danger of tilting over, which requests the reservation of a certain space, diminishing to the same extent the accumulator capacity. Several attempts have been made to reduce this disadvantage:

- providing for an elastic system (such as springs), which allows to pull one carriage axis very close to the next one, when pushing the support strip carriages together (JP H03 91118 U);
- having two pairs of rails allowing telescoping of the carriages when pushed together (DE 102004042595 A1, DE 3925193 A1), but it is not foreseen that the support carriages could enter into the accumulator carriage;
- having a central "I" profile to allow telescoping of an open triangular base of the carriages (Chinese design patent ZL201120051403,0).

[0009] Possible danger of avoiding the carriage tilting over is sometimes considered in the known designs:

- using rails allowing hooks coming underneath the rail to avoid the wheels leaving it. But this simple system generates a braking effect, when the carriage makes a tilting movement (CN 201665446 U);
- putting the rails at half height, which diminishes the tilting over moment, but which does not allow erecting on flat ground without a special supporting structure for the rails and which does not take away the danger of tilting over (FR 2 698 803 A1);
- using cam rollers running within an central open "H" or "I" profile, linked to the carriage (Chinese design patent ZL201120051403,0). This solution has the disadvantage that the lowest strip strand is high due to the linking elements between the carriage and the cam rollers.

[0010] The hooking and unhooking system is most crucial for a system with no proper strip support carriage drive:

- the most common hooking system is used by the rail ways, but it needs manual actions for hooking as well as unhooking. It has the big advantage that the efforts of towing are applied in the carriage axis;
- there are several hooking systems, which need at

least during one operation, either hooking or unhooking, an active system (electric, hydraulic/pneumatic or manual force or their combination) (DE 2425181 A1, US 791,445 A) ;

- the automatic coupling system (uncoupling by a cam or manual action) described in DE 2425181 A1 is provided with horizontal hooks and return springs.

[0011] A completely passive system is used in the horizontal strip accumulator (FR 2 698 803 A1) using a hook and cam system with complicated locking/unlocking, but it is not applied in the carriage centre, which requests special precautions, especially for carriage guiding on the rail and for the rail fixations.

Aims of the invention

[0012] The present invention aims at avoiding drawbacks on prior art. In particular, the invention pursues the following goals:

- designing a strip support carriage, which does only diminish the theoretical accumulator capacity by the presence of these carriages at a possible minimum ;
- allowing erection on flat ground having the lowest strip strand as low as possible without adverse effect ;
- using a passive hooking and unhooking system at specified locations, which is in the centre of the carriages to avoid non desired efforts in the rails.

Summary of the invention

[0013] The present invention relates to a horizontal strip accumulator installation in a continuous strip processing line, comprising a looping carriage riding on a pair of external rails, which enlarges or diminishes strip loops in order to maintain a constant strip speed in a processing section, while an adjacent processing section runs for a certain time at a different speed, with a plurality of strip supporting carriages, each comprising a vertical frame disposed on two wheels riding on the same external rails, having traverses and supporting rolls located transversally with regard to the vertical frame to support the strip between the looping carriage and a strip feeding location, characterised in that the vertical frame is connected on each side of the strip to inclined brackets provided with guiding cam rollers riding in respective guiding profiles or girders located under the rails, so as to guide the strip supporting carriage on the external rails in an anti-tilting-over manner.

[0014] According to preferred embodiments, the installation of the invention also includes one or more of the following characteristics:

- the guiding profiles or girders are "C", "H", "I" or "U" profiles;
- the lowest traverse of the frame is provided in its centre with a fixed hook on the rear side and with a hook eye, which can be raised and lowered thanks to an articulation, on the front side, or vice versa, in order to automatically hook the strip supporting carriage to a next one or to the looping carriage when it comes sufficiently close thereof;
- the fixed hook is internally provided with a hook opening capable to accommodate the hook eye of the following strip supporting carriage;
- the hook is provided externally with a slope part capable to raise the hook eye until it falls in the hook opening for hooking;
- the hook eye is mounted so that it cannot be lowered below the lowest end of the slope part;
- the installation further comprises a stationary unhooking cam system, the centrally located hook eye being provided with a hook eye traverse, which is wider than the strip width and narrower than the interior part of the frame, each end of the hook eye traverse being provided with a cam roller so that the stationary unhooking cam system is able to automatically unhook the strip supporting carriage from a next one or from the looping carriage by raising the cam roller;
- the stationary unhooking cam system is provided with a slope suitable to unhook a strip supporting carriage from a next one or from the looping carriage when the cam roller attached to the hook eye traverse travels over the slope of the stationary unhooking cam system, the latter being provided with a return stop cooperating with a corresponding spade on the traverse to prevent any backwards movement solely of said unhooked strip supporting carriage;
- the height of each carriage hook eye traverse with cam roller and spade and of its corresponding unhooking cam system with its return stop is arranged so that unhooking and return stop work only for a particular strip supporting carriage, while the other still hooked support carriages are not affected;
- each strip supporting carriage is designed to be stopped smoothly by one or more shock absorbers in its forward movement at the instant of unhooking in its specific location, the latter being defined by one or more buffer stops cooperating with the respective shock absorbers;
- the shock absorbers are either on the support carriage or on a fixed post and the stops are on a fixed post or on the support carriage respectively, and they are arranged so that only the just unhooked strip supporting carriage is stopped;
- the shock absorbers and the corresponding stops for different support carriages are arranged at different respective heights;
- extra shock absorbers are fixed on at least a traverse on the front or the back side respectively of each strip supporting carriage and on the back side of the looping carriage to soften the contact and backwards

acceleration between the train made of the accumulator carriage and/or the hooked-on strip supporting carriages moving backwards to collect and hook the strip supporting carriages stopped in their dedicated locations;

- the strip supporting rolls are directly attached to the vertical frame or on particular traverses;
- guiding cam rollers are also provided to the vertical frame at least close to one wheel, to guide each strip supporting carriage laterally on either side of the rail.

Short description of the drawings

[0015] FIG.1 represents an elevation view of the strip supporting carriages according to the present invention.

[0016] FIG.2 represents a cross-sectional front view of the strip supporting carriages according to the present invention.

[0017] FIG.3 represents a detailed elevation view of the hooking/unhooking system according to the present invention.

[0018] FIG.4 represents a plan view of the hooking/unhooking system according to the present invention.

Detailed description of the invention and preferred embodiments thereof

[0019] According to a preferred embodiment of the present invention (FIG. 1 and 2), the horizontal accumulator 1 comprises strip supporting carriages 2 specifically consisting of a vertical frame 3 disposed on two wheels 4 riding on the same rails 5 as the accumulator looping carriage (the latter not shown). These frames 3 are equipped with the necessary strip supporting rolls 6. The traverses 7 of the frame 3 are located where they do not hinder the strip loop 10.

[0020] The forward movement of the looping carriage, corresponding to the enlarging of the strip loops, defines the sides of the carriages. The front side of the carriage corresponds to the side turned to the direction of forward movement or of enlarging loops. The back side of the carriage corresponds to the side turned to the direction of backwards movement or of reducing loops.

[0021] Brackets 8 are fixed under a given angle to the vertical frame 3 on either side. These brackets 8 are equipped with cam rollers 12 riding in an open profile 9, having for example a shape of type "C", "H", "I" or "U", a which is located under the rails 5, in order to obtain a guiding and anti-tilting-over system 11 of the frame 3. These brackets 8 can be either on the inner or outer side of the frame 3, according to the design requirements.

[0022] Guiding cam rollers 12 are also provided to the vertical frame 3 to guide each strip supporting carriage 2 laterally on either side of rail 5 close to a wheel 4.

[0023] Further according to a preferred embodiment (FIG. 3 and 4), the lowest traverse 7 of the frame 3 has, in its centre, a fixed hook 13 on one side, and a hook eye 14 on the other side, the latter being capable to be raised and lowered thanks to an articulation. This hook eye 14 cannot be lowered below the lowest end of an external slope 15 of the adjacent hook 13 allowing an automatic hooking to the next strip supporting carriage 2 or to the accumulator carriage, when it comes close thereto. The hook eye 14 is then raised by progressive sliding on the slope 15 of the hook 13 until if falls in hook opening 16.

[0024] The hook eye 14 is equipped with a traverse 17, which is wider than the strip 10, but smaller than the interior of the frame 3 (FIG. 2). At dedicated stationary locations an unhooking cam system 18 underneath the lower carriage traverse 7 raises a hook eye traverse cam roller 20 thanks to a slope 19, when this cam roller 20 travels over the latter, which results in the desired unhooking of the carriage 2 (FIG. 3). The hook eye 14 and its traverse 17 are in a lower position than being hooked, when riding backwards after unhooking. This effect is used to provide with cooperating spade 24 and the backwards stop 21 a support carriage lock preventing its possible further backwards movement. When the hook eye 14 is raised for hooking, as described above, the spade 24 on the traverse 17 is higher than the return stop 21 and backwards travelling is possible.

[0025] The height of the cam roller 20 located on the traverse 17 and the unhooking and backwards stop system 18 and 21 have to be arranged in such a way that it does work only for the dedicated strip support carriage 2, while the other, still hooked, support carriages are not affected. This can also be achieved by varying the width of the different traverses.

[0026] Still according to a preferred embodiment, a shock absorber 22 is provided to stop the forward movement of each strip supporting carriage 2 at the instant when the latter is unhooked in its specific location. The shock absorbers 22 and their respective buffer stops 23 are arranged so that only the right unhooked strip supporting carriage 2 is stopped, e.g. arranged at different heights. Other shock absorbers 22 located this time on the strip supporting carriage traverse soften the contact and backwards acceleration between the train made of the accumulator carriage and/or the hooked-on strip supporting carriages moving backwards to collect and hook the strip supporting carriage stopped in its desired location.

[0027] The strip supporting rolls 6 are fixed to the frame 3 either on its vertical parts or on particular roll traverses, if separated rolls over the width are used.

Advantages

[0028] The present invention shows the following advantages.

[0029] A first advantage of this strip supporting system is the minimum of space necessary for accommodating the strip supporting carriages, while the latter are still fulfilling their required functions. No extra drive or transmission system is necessary for them. Another advantage is that using a rail attached onto an open profile is

beneficial for the rail attaching system and does not affect the total accumulator height.

[0030] In case the accumulator has to be erected on a steel structure, the girders under the rails can be used for the guiding and anti-tilting-over system.

[0031] The simple unhooking, locking and hooking system according to the present invention is completely mechanic and automatic, without needing any external power, that means it is passive. It has the great advantage being lodged in the carriage centre avoiding undesired efforts or moments in the system, which requires special devices to overcome or prevent mechanical problems. This allows using open U or similar profiles for the support carriage framework, resulting in lighter strip supporting carriages.

[0032] The following disadvantages are also to be expected however.

[0033] A first disadvantage is that two extra open profiles are necessary under the rails, but they have also a beneficial counterbalancing effect as there will be less fixations on the ground than with usual rail arrangement.

[0034] The brackets with their cam roller system replace in a favorable manner the second pair of wheels requested by prior art solutions, but it makes the system a bit wider.

List of reference symbols

[0035]

1	horizontal accumulator
2	strip supporting carriage
3	vertical frame
4	wheel
5	rail
6	supporting roll
7	traverse
8	bracket
9	guiding profile
10	strip loop
11	anti-tilting-over system
12	guiding cam roller
13	hook
14	hook eye
15	hook slope
16	hook opening
17	traverse of the hook eye
18	unhooking cam system
19	unhooking cam system slope
20	hook eye cam roller
21	backwards stop
22	shock absorber
23	buffer stop
24	spade of the traverse of the hook eye
25	bottom strip support roll

Claims

1. A horizontal strip accumulator installation (1) in a continuous strip processing line, comprising a looping carriage riding on a pair of external rails (5), which enlarges or diminishes strip loops in order to maintain a constant strip speed in a processing section, while an adjacent processing section runs for a certain time at a different speed, with a plurality of strip supporting carriages (2), each comprising a vertical frame (3) disposed on two wheels (4) riding on the same external rails (5), having traverses (7) and supporting rolls (6) located transversally with regard to the vertical frame (3) to support the strip (10) between the looping carriage and a strip feeding location, **characterised in that** the vertical frame (3) is connected on each side of the strip to inclined brackets (8) provided with guiding cam rollers (12) riding in respective guiding profiles or girders (9) located under the rails (5), so as to guide the strip supporting carriage (2) on the external rails (5) in an anti-tilting-over manner.

2. The horizontal strip accumulator installation (1) according to Claim 1, **characterised in that** the guiding profiles or girders (9) are "C", "H", "I" or "U" profiles.

3. The horizontal strip accumulator installation (1) according to Claim 1, **characterised in that** the lowest traverse (7) of the frame (3) is provided in its centre with a fixed hook (13) on the rear side and with a hook eye (14), which can be raised and lowered thanks to an articulation, on the front side, or vice versa, in order to automatically hook the strip supporting carriage (2) to a next one or to the looping carriage when it comes sufficiently close thereof.

4. The horizontal strip accumulator installation (1) according to Claim 3, **characterised in that** the fixed hook (13) is internally provided with a hook opening (16) capable to accommodate the hook eye (14) of the following strip supporting carriage (2).

5. The horizontal strip accumulator installation (1) according to Claim 3, **characterised in that** the hook (13) is provided externally with a slope part (15) capable to raise the hook eye (14) until it falls in the hook opening (16) for hooking.

6. The horizontal strip accumulator installation (1) according to Claim 5, **characterised in that** the hook eye (14) is mounted so that it cannot be lowered below the lowest end of the slope part (15).

7. The horizontal strip accumulator installation (1) according to Claim 3, **characterised in that** it further comprises a stationary unhooking cam system (18), the centrally located hook eye (14) being provided

with a hook eye traverse (17), which is wider than the strip width and narrower than the interior part of the frame (3), each end of the hook eye traverse (17) being provided with a cam roller (20) so that the stationary unhooking cam system (18) is able to automatically unhook the strip supporting carriage (2) from a next one or from the looping carriage by raising the cam roller (20).

8. The horizontal strip accumulator installation (1) according to Claim 7, **characterised in that** the stationary unhooking cam system (18) is provided with a slope (19) suitable to unhook a strip supporting carriage (2) from a next one or from the looping carriage when the cam roller (20) attached to the hook eye traverse (17) travels over the slope (19) of the stationary unhooking cam system (18), the latter being provided with a return stop (21) cooperating with a corresponding spade (24) on the traverse (17) to prevent any backwards movement solely of said unhooked strip supporting carriage (2).

9. The horizontal strip accumulator installation (1) according to Claim 8, **characterised in that** the height of each carriage hook eye traverse (17) with cam roller (20) and spade (24) and of its corresponding unhooking cam system (18) with its return stop (21) is arranged so that unhooking and return stop work only for a particular strip supporting carriage (2), while the other still hooked support carriages are not affected.

10. The horizontal strip accumulator installation (1) according to Claim 1, **characterised in that** each strip supporting carriage (2) is designed to be stopped smoothly by one or more shock absorbers (22) in its forward movement at the instant of unhooking in its specific location, the latter being defined by one or more buffer stops (23) cooperating with the respective shock absorbers (22).

11. The horizontal strip accumulator installation (1) according to Claim 10, **characterised in that** the shock absorbers (22) are either on the support carriage or on a fixed post and the stops (23) are on a fixed post or on the support carriage respectively, and they are arranged so that only the just unhooked strip supporting carriage (2) is stopped.

12. The horizontal strip accumulator installation (1) according to Claim 11, **characterised in that** the shock absorbers (22) and the corresponding stops (23) for different support carriages are arranged at different respective heights.

13. The horizontal strip accumulator installation (1) according to Claim 1, **characterised in that** extra shock absorbers (22) are fixed on at least a traverse (7) on the front or the back side respectively of each strip supporting carriage (2) and on the back side of the looping carriage to soften the contact and backwards acceleration between the train made of the accumulator carriage and/or the hooked-on strip supporting carriages (2) moving backwards to collect and hook the strip supporting carriages (2) stopped in their dedicated locations.

14. The horizontal strip accumulator installation (1) according to Claim 1, **characterised in that** the strip supporting rolls (6) are directly attached to the vertical frame (3) or on particular traverses (7).

15. The horizontal strip accumulator installation (1) according to Claim 1, **characterised in that** guiding cam rollers (12) are also provided to the vertical frame (3) at least close to one wheel (4), to guide each strip supporting carriage (2) laterally on either side of the rail (5).

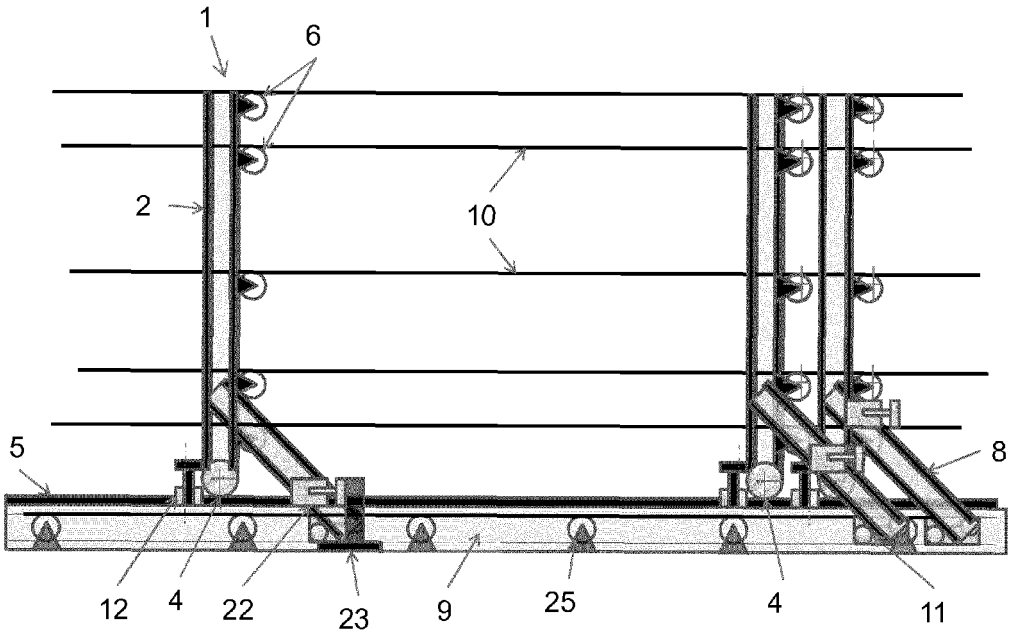

FIG. 1

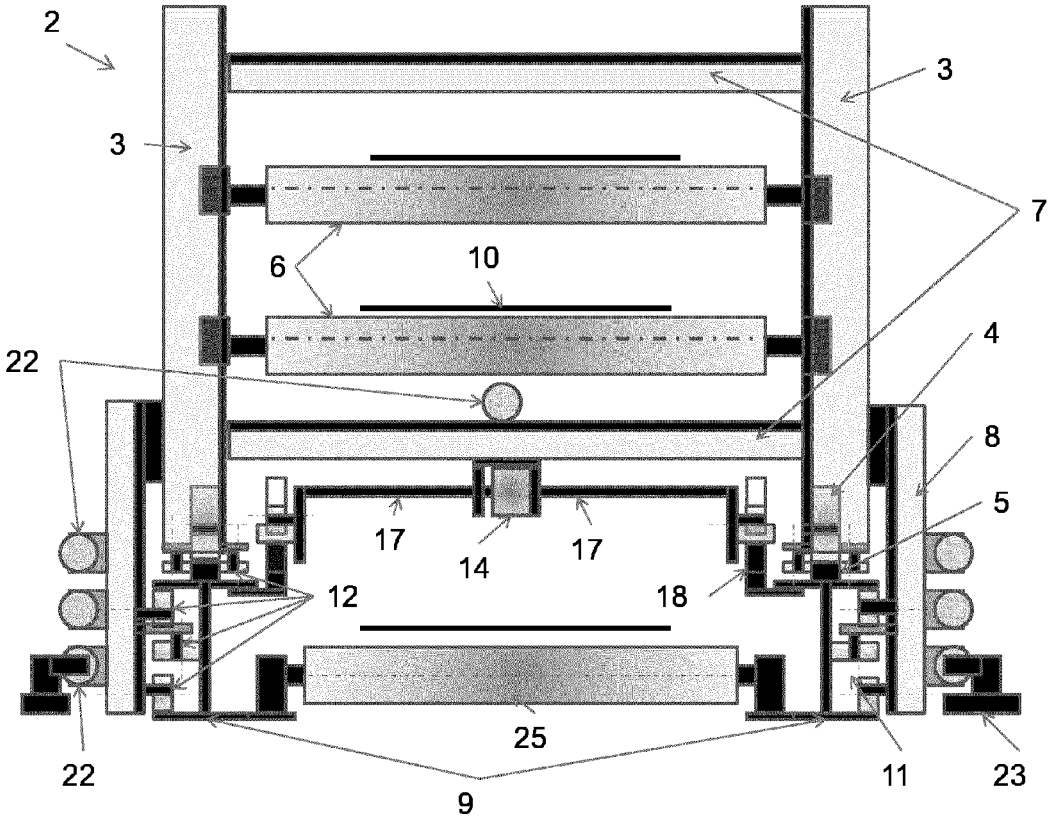

FIG. 2

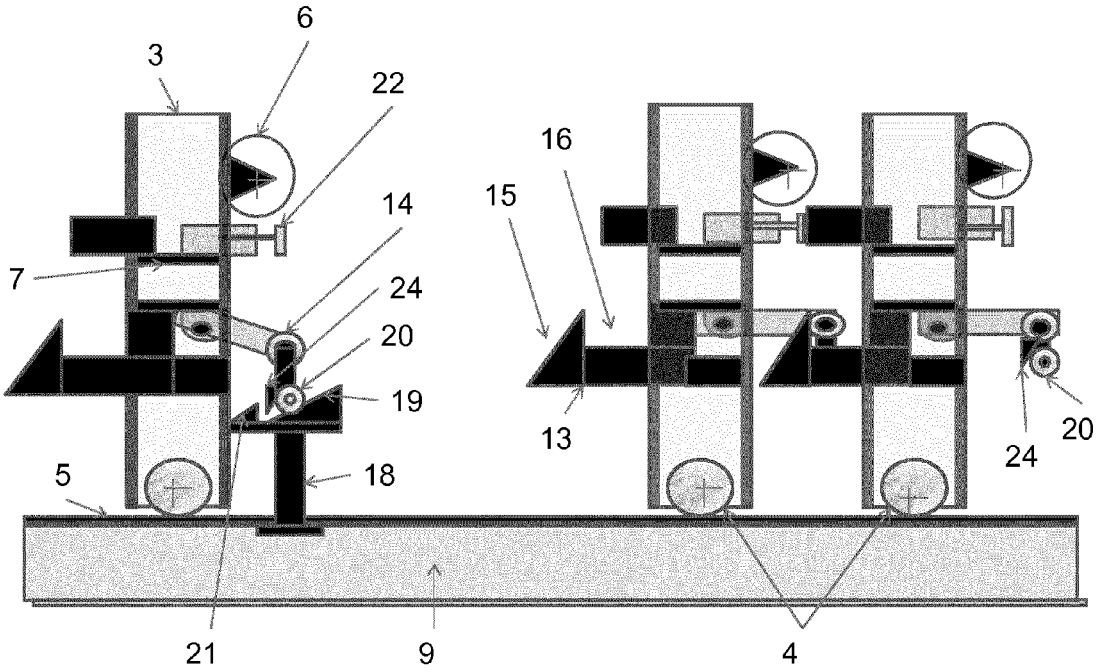

FIG. 3

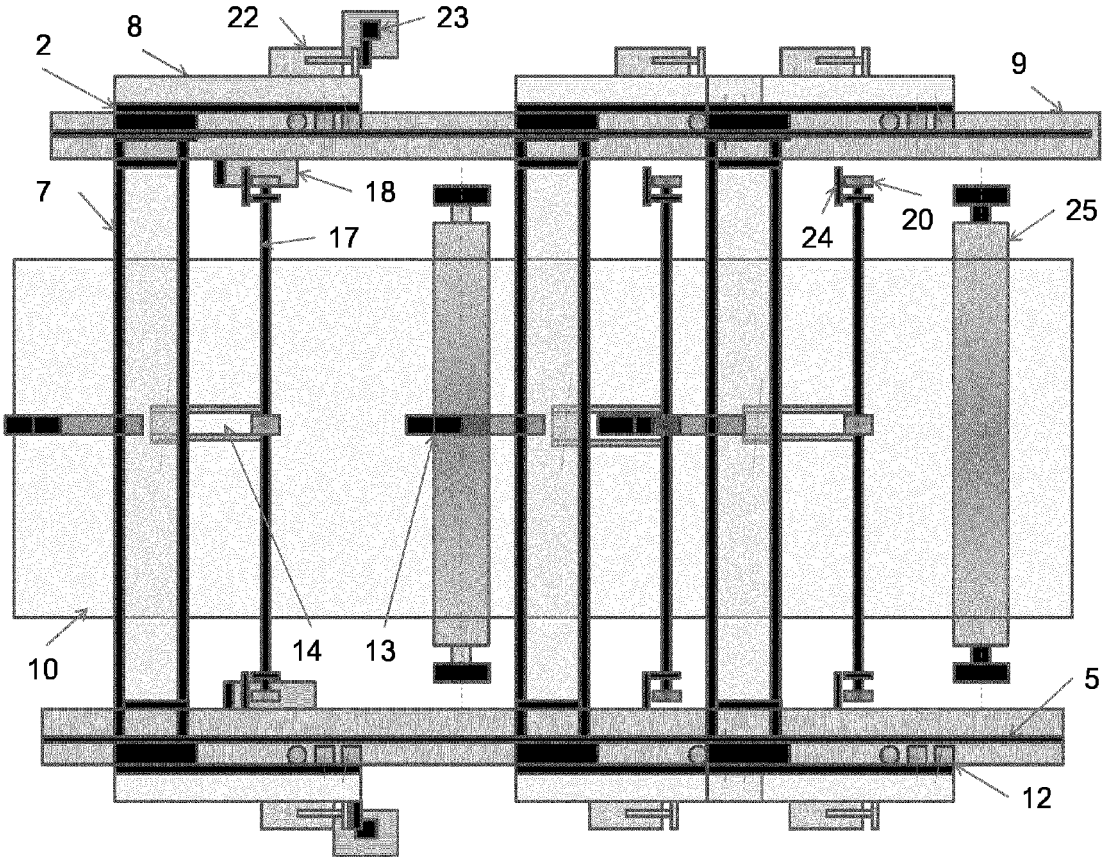

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 13 15 2589

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 2 468 428 A1 (COCKERILL MAINTENANCE & INGENIERIE [BE]) 27 June 2012 (2012-06-27) * paragraphs [0001], [0013], [0014], [0015], [0016], [0024], [0025], [0027] * * figures 1-7 *	1-15	INV. B21C49/00 B65H20/32
A,D	JP H03 91118 U (.) 17 September 1991 (1991-09-17) * figures 1-3 *	1	
A	JP H05 57347 A (KAWASAKI STEEL CO) 9 March 1993 (1993-03-09) * figures 3-6 * * abstract *	3-7	
			TECHNICAL FIELDS SEARCHED (IPC) B21C B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	10 July 2013	Cescutti, Gabriel

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10-07-2013

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REFERENCES CITED IN THE DESCRIPTION

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