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(54) **Automatic feeder for electrowelded metal nets**

(57) The present invention concerns an automatic feeder for electrowelded metal nets including: at least one conveyor bed (2) means, the conveyor bed (2) means having a horizontal surface for supporting a pack of stacked nets and being adapted for moving vertically and horizontally; means adapted for recognizing the geometric orientation and/or the structural configuration of a net, the net being arranged individually or stacked above the pack of stacked nets, means adapted for actuating automatically an arm, the arm being adapted to handle the net and to position the net correctly on a net

working machine or to place the net on means (13) for turning the net, at least one upper beam means extending above the net stacked in the pack, the upper beam means being adapted to support the means for recognizing the geometric orientation and/or the structural configuration of a net, the means for recognizing the geometric orientation and/or the structural configuration of a net being adapted to communicate and actuate, by virtue of automation methods, the arm, and at least one separator means which are capable of being inserted from an external position to a position within the stack of nets.

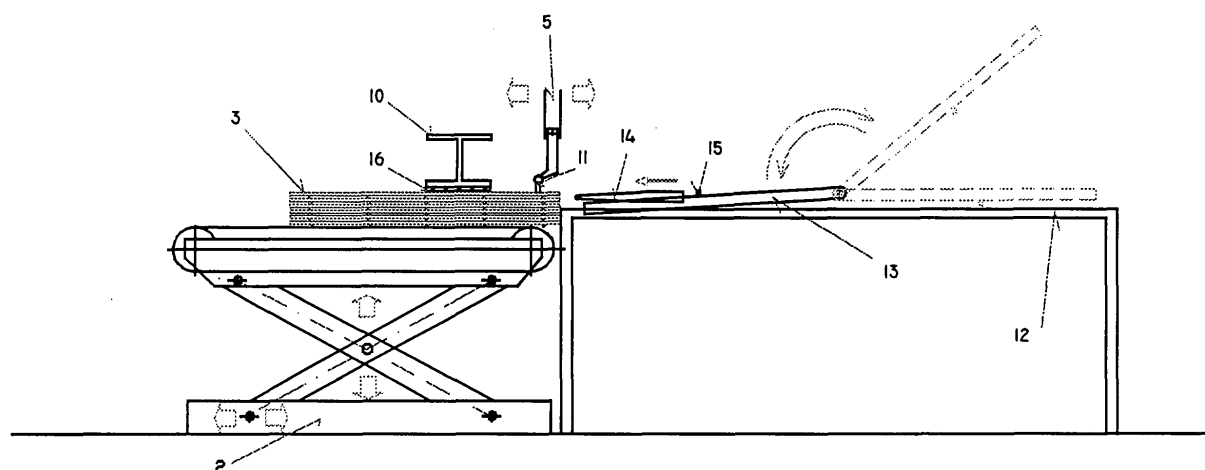


FIG. 2

Description

FIELD OF APPLICATION

[0001] The present invention relates to an automatic feeder for electrowelded metal nets suitable for reinforcing concrete castings, which is suitable to position said nets in an optimum manner at net bending machines, operating by starting from said nets stacked in any manner and/or with methods entailing minimum space occupation, i.e., with longitudinal and/or transverse rods arranged alternately side by side. Said feeder, in addition to recognizing in each instance the net when it is gripped, automatically positions said net correctly on the bending unit, also turning it over spatially if necessary. The feeder is capable of operating on large electrowelded metal nets (measuring for example 7 meters in length and 3.6 meters in width).

BACKGROUND ART

[0002] Various kinds of automatic feeders for electrowelded metal nets are known in the background art and are composed of multiple automated devices that initially work on individual nets that arrive from forming units or from stacks of nets arranged so that they all have the same orientation.

[0003] Currently, the facilities that manufacture said electrowelded metal nets, in order to reduce transport bulk and costs, form the packs of nets by continuously alternating their orientations, thus reducing (for an equal number of nets) the height of the pack. This technical solution, ideal for the transportation step, is at the same time much more troublesome in the subsequent steps of the working of the electrowelded metal nets, particularly during the step for handling them in order to prearrange them exactly on the bending units or on the other machine tools (for example for cutting, shaping, curving, et cetera).

[0004] This entails an auxiliary processing step ahead of the net working equipment, in order to achieve its correct spatial prearrangement for subsequent work. This drawback negatively affects the working time and therefore the final cost of the finished product.

SUMMARY OF THE INVENTION

[0005] The aim of the present invention is to overcome the drawbacks noted in current apparatuses for working electrowelded metal nets. The object of the invention is therefore to:

- provide an automatic feeder or prearrangement unit for nets that arrive from packs stacked in various manners, capable of arranging them one at a time ahead of the working machines so that they all have the same orientation, in order to be able to perform an automatic and continuous production cycle;

- provide a feeder constituted by an intelligent electromagnetic device or by another equivalent technique that is capable of recognizing the orientation of the net and of lifting one net at a time from the stack and grip it with suitable clamps that can move to convey it on a suitable automatic device with an overturning table;
- provide a feeder for electrowelded metal nets that is capable of working on nets of any size and configuration.

SUMMARY OF THE INVENTION

[0006] The aim and object of the present invention are achieved according to the characteristics of the main claim and/or of any other claim cited in the present application document, by providing an automatic feeder for electrowelded metal nets that is suitable to work upstream of a bidirectional bending unit or of other automatic machines.

[0007] The feeder according to the present invention is an intelligent unit for geometric recognition of electrowelded metal nets that uses electromagnetic methods and/or optical sensors and/or other equivalent systems known to the person skilled in the art.

[0008] Apparatuses for working electrowelded metal nets can work on nets assembled on-site in-line (and in this case the present invention is unnecessary), or on stacked nets that arrive from other steelworks or other separate apparatuses. In these last cases, unfortunately, the nets (due to transportation cost reasons) are usually stacked alternately in order to reduce their space occupation for an equal number of nets. They are superimposed and stacked alternately, reducing their volume by up to 50%. This entails, as already mentioned earlier, a waste of time caused by their handling to arrange them with the correct orientation for subsequent work. Automatic net processing machines must in fact be fed with nets that are all arranged with the same orientation, as otherwise the finished product is structurally unsuitable for its final use (for example in the building of frames and lattice-like structures for concrete castings).

[0009] The automated feeder for haphazardly or alternately stacked metal nets uses, upstream, a static conveyor platform for packs of nets, which acts as a storage system and feeds a platform that can move in a vertical direction and has a function to self-level the upper net of the pack with respect to the horizontal working surface and to the unit for geometric recognition of the net.

[0010] The unit for geometric recognition of the net can use various known techniques, from the electromagnetic system to the optical system, from the use of presence sensors to pneumatic systems. However, in this case, an electromagnetic system for recognizing the orientation of the nets has been used which is based on a plurality of electromagnets, which are variously ar-

ranged on a horizontal surface below a (fixed and/or movable) supporting beam that covers the entire length of the nets. Such electromagnets cooperate in mutual coordination and are suitable to recognize the presence or absence of the metal rods that constitute the net. To facilitate this recognition step, the bed that carries the pack of nets rises vertically until it places the first upper net in contact with the lower surface of the electromagnet supporting beam. Once recognition has occurred, said bed moves downward slightly, leaving the net attracted by the electromagnets suspended. Moreover, said electromagnets control the correct positioning of an upper movable arm, which is equipped with automatic pincers capable of gripping, laterally at one end, a single net and more specifically the net identified and kept raised by the electromagnets.

[0011] At this point, between the net kept raised from the pack by the grip arm and the underlying net, there is a gap that is sufficient for the passage of a device with slender horizontal spikes, which are inserted on command between the lower surface of the raised net and the upper surface of the first upper net of the slightly lowered pack, facilitating the separation of the net raised only partially by said arm from the remaining nets of the pack. The separated net is identified and is dragged by the movable arm onto an overturning device, which is activated automatically only if it is necessary to turn over the net for the subsequent step of normal bending (with a net bending machine) or bidirectional bending (with two oppositely arranged net bending machines); otherwise, said net is simply arranged correctly on the net bending machine for the subsequent working step.

[0012] The net gripping arm can move and is suspended above the working surface and is equipped with appropriate clamps suitable to drag the net horizontally and is actuated in its movements by suitable automation systems.

[0013] The overturning device is meant to automatically turn the net over through 180° if it is upside-down with respect to the correct subsequent working step. Said device is composed of a plurality of bars arranged on a horizontal rotating surface, which is pivoted laterally about an axis that is parallel to the working axis of the bending machines and is perpendicular to the advancement direction of the nets. The bars that form the supporting surface for the net to be turned over are provided with suitable gripping clamps or with other suitable means (for example electromagnets) in order to retain the net during overturning.

[0014] Accordingly, the feeder as described is capable of feeding and prearranging the net automatically in the intended spatial orientation, regardless of its initial arrangement, upstream of a working machine or of a bending unit, of a simple type or of the type composed of two mutually opposite automatic bending machines that can be moved in a programmable manner as regards distance with respect to each other.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] An embodiment according to the present invention is illustrated by way of preferred but non-limiting example in the accompanying drawings, wherein:

Figure 1 is a schematic side view of an automatic system for bending electrowelded metal nets, with a device for turning over the nets upstream of the two mutually opposite bending machines;

Figure 2 is a side view of the device for automatically turning over electrowelded metal nets according to the present invention, illustrating the beam for supporting the recognition devices (of the electromagnetic type), the arm for gripping and moving the net, the movable unit for separating the nets, and the overturning unit;

Figure 3 is a side view of the movable net separation unit in action while a net is kept raised by the grip arm;

Figure 4 is a side view of the step for moving the net that follows Figure 3, with conveyance of the net, turned over through 180°, onto the overturning unit;

Figure 5 is a side view of the step for turning over the net ahead of the mutually opposite movable net bending machines;

Figure 6 is a plan view of Figure 2, illustrating the beam for supporting the recognition devices and the movable units for separating and overturning the net.

[0016] As shown in the accompanying figures, the automatic feeder for electrowelded nets is arranged upstream with respect to the two mutually opposite movable bending machines 8 and 9 and downstream with respect to the conveyor 1 of the packs of variously stacked electrowelded metal nets 3 that arrive from production facilities that are external to the working apparatus or are produced directly in-line or not in-line. The net working apparatus as shown in Figure 1 is in turn provided with a particular conveyor unit 2 for packs of nets 3, with a vertically movable supporting surface, which is also capable of arranging the nets so that they are aligned along an abutment plane, and a bed for the transit of the nets 12, which lies transversely with respect to the work advancement direction of said nets. In order to move the nets, there are provided as follows: overhead carriages that support arms with automatic net gripping clamps 4; a carriage with an automatic arm 5 upstream of the bending machines 8 and 9, for serving the net recognition device 4, with three-dimensional movements; a carriage with a beam that supports automatic grip clamps 6, with movement on a vertical plane, and which is arranged between the two mutually opposite movable bending machines and serves them; and finally a carriage with an automatic arm 7, downstream of the bending machines, with three-dimensional movements, for

serving the evacuation of the products.

[0017] Accordingly, the automatic feeder for electrowelded metal nets consists of a bed 2 for conveying packs of variously stacked nets 3, which is capable of moving the nets in the work direction of the apparatus and at the same time of aligning them on a vertical plane, formed by the static work bed 12 and arranged transversely to the work flow. Said conveyor bed 2 can also move vertically in order to lift and/or lower the pack of nets on command with respect to the net recognition devices 16 (of the electromagnetic, optical or other equivalent type), supported by a transverse fixed beam 10 that lies above said pack. The geometric recognition of the upper side of the net at the top of the pack of variously stacked nets in fact occurs by means of recognition devices that are arranged on the lower face of the beam 10 and that identify the characteristics of the first upper metal net of the pack and automatically actuate the carriage 5 with the arm equipped with automatic clamps 11 for gripping and moving the net.

[0018] At this point, the automatic feeder, since electrowelded metal nets are generally large and can interlock during the preceding step for forming the packs or during their ordinary transport, separate the first upper net from the second underlying one: this occurs by virtue of the intervention of a particular separator unit 14, which can move horizontally on command and is capable of inserting itself below the first upper net 4, which is supported and raised by the clamps of the arm 5, when the bed that conveys the pack of nets 2 moves downward. The horizontal insertion of the wedge-shaped device 14 with multiple aligned elements between the lower surface of the first upper net of the pack and the upper surface of the second net of the pack facilitates the transfer of the recognized net onto the overturning unit (if it is necessary to rotate it through 180°) or by arranging it directly in the correct way on the bending machines 8 and 9.

[0019] If the net recognized by the devices 16 is upside-down with respect to future work, said devices also activate automatically the overturning step of the respective mechanical unit 13. Said overturning unit 13 consists of a plurality of rotating arms, which are pivoted at 17 about a horizontal axis that is perpendicular to the direction of the work flow and which are provided with suitable automatic grip clamps 15 that are capable of retaining the net during the rotation through 180° of the arms to arrange it with the correct orientation on the working surface 12, upstream of the bending machines or directly on them in order to be gripped by the clamps of the vertical movement carriage 8 that serves said machines.

[0020] As it is evident, the present invention can be applied to serve any other machine for working on electrowelded metal nets, including machines that are different from those considered by way of example in the present application.

[0021] The invention is of course not limited to the ex-

ample of embodiment described above, starting from which it is possible to provide other embodiments and forms, and the details of execution may vary in any case without thereby abandoning the essence of the invention as stated and claimed below.

[0022] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. An automatic feeder for electrowelded metal nets, capable of recognizing the upper geometric orientation and the structural configuration of said net (4), which is arranged individually or stacked above a pack (3) of stacked nets, and of actuating automatically the arm (5) provided with suitable grip clamps (11), which is suitable to handle the net and to position it correctly individually, directly on the net working machines (for example the bending units (8, 9)), or preliminarily on an appropriately provided device for turning over through 180°, in order to turn the net over before working, **characterized in that** it is provided with the following automated units (managed and actuated with computerized automation methods) in mutual coordination and cooperation:

- at least one conveyor bed (2) for packs of stacked metal nets (3), supported by a horizontal surface that is capable of moving vertically and horizontally on command;
- at least one fixed upper beam (10), which is horizontal and perpendicular to the work flow and covers the entire span of the maximum width of the metal nets stacked in a pack and supported by the conveyor bed (2), said beam being suitable to support the devices for geometric recognition of the electrowelded metal nets;
- a plurality of devices (16) (for example electromagnetic and/or optical and/or other devices), suitable for the geometric and structural recognition of electrowelded metal nets, which are applied to and supported by the beam (10) and are suitable to communicate and actuate, by virtue of automation methods, the arm (5) with grip clamps, directing them correctly in said step and for the subsequent transfer of the nets onto an overturning unit or onto the bending machines or for other processing;
- at least one movable carriage with an arm (5), which is capable of operating in three dimensions and is provided with a plurality of auto-

- matic grip clamps for metal nets, capable of gripping said nets correctly and/or arranging them on command on the overturning unit (13) and/or on the working surface (12) and/or directly on the machines for working them;
- at least one separator (14), which is composed of a plurality of slender wedges, which are aligned at right angles to the work flow of the net, with automatic horizontal movement, and are capable of being inserted from an external position to a position within the stack of nets, and more precisely, when the first upper net of the pack is kept raised by the arm (5) and the remaining part of the pack is lowered, between the lower surface of the first raised net and the upper surface of the second net of the pack;
 - at least one unit (13) for turning nets over through 180°, from a horizontal position to an upside-down horizontal position, which is composed of a plurality of aligned supporting arms, which rotate simultaneously, are pivoted about the horizontal axis, are perpendicular to the work direction, and are provided with automatic clamps (15) for gripping the net (4) to be turned over;
 - devices for verifying and checking the presence of the net in the various steps of identification and automated handling of the electrowelded metal net;
 - having the following operating sequence:
 - a) in the presence of a horizontal pack of electrowelded metal nets, stacked haphazardly (with different and/or identical adjacent surfaces) or stacked with the correct orientation (all with the same orientation) for the subsequent work (or also all stacked with the opposite orientation with respect to the orientation of the subsequent work), on the transfer bed (2), which can move vertically and horizontally on command, the lateral ends of the nets are made to adhere and are aligned along a vertical plane that is perpendicular to the work advancement flow;
 - b) said pack of nets (3) is raised, by means of the transfer bed (2), until the upper gridlike surface of the first net at the top of the stacked pack adheres to, or approaches, the recognition devices (16) arranged on the lower part of the transverse beam (10);
 - c) once recognition of the structural geometry of the upper surface of the first net at the top of the pack has occurred, the corresponding devices actuate the automatic positioning of the overlying arm (5), which can move in three dimensions and is provided with appropriate grip clamps (11) for correctly locking the net on the lateral side (at right angles to the work flow); furthermore, once the orientation of the net has been recognized, the net is automatically either sent directly to the bending machine or other machine, or transferred onto the unit for turning over through 180°; at the same time, the lowering of the transfer bed that supports the pack of nets is actuated, leaving only the first gripped and identified net in a raised position;
 - d) at this point, the net separation unit (14) starts to operate, said unit being composed of multiple slender and aligned wedges, which move horizontally from a position that is external to the pack, penetrating between the suspended net (4) and the second net that lies on the lowered pack; from this moment, the recognized net can be transferred, by dragging with the arm (5) or to the overturning unit or can be arranged directly at the bending machines (8, 9) or others;
 - e) if the upper side of the recognized net is arranged opposite with respect to the optimum one provided for the subsequent work, said net is transferred and positioned onto overturning arms (13), which are equipped with appropriately provided clamps (15) or other equivalent systems, in order to rotate said net through 180° with respect to the side that is perpendicular to the work flow;
 - f) once rotation has been performed, the net is then arranged on the mutually opposite bending machines (8, 9), which are movable and are orientated at right angles with respect to the work flow; this is followed by activation of the vertical carriage (6) for the programmed operations for bending or other work, and of the carriage (7) for evacuating the finished products.
2. The automatic feeder according to claim 1, **characterized in that** the same uses devices for structural and geometric recognition of the electrowelded metal net stacked on packs of haphazardly piled net, said devices being of the electromagnetic and/or optical and/or mechanical and/or pneumatic type and/or of a type that uses known equivalent methods, in order to manage and control the subsequent operating steps according to the configuration of the recognized net.
3. The automatic feeder according to claim 1, **characterized in that** the overturning unit (13) automatically performs, in accordance with the commands

received from the recognition device, the rotation through 180° of the net upstream of the bending and/or working machines on an appropriately provided surface or directly on the working machines.

4. The automatic feeder according to claim 1, **characterized in that** the movable bed (2), which can move vertically and horizontally, is actuated in its movements, particularly the vertical movement, by suitable means for detecting the presence of the net proximate to the upper fixed beam that supports recognition devices.

5. The automatic feeder according to claim 1, **characterized in that** the beam (10) that supports devices for structural and geometric recognition of the net is fixed or vertically and/or horizontally movable with respect to the pack of the nets to be recognized.

6. The automatic feeder according to claim 1, **characterized in that** the packs of nets, stacked even haphazardly, are arranged on the horizontal surface of the platform (1 or 2), as normally conveyed by internal or on-road means of transport.

7. The automatic feeder according to claim 1, **characterized in that** the packs of stacked nets are arranged on a bed (1) in vertical position (i.e., with its sides acting as supporting base), and the individual nets are turned through 90° one at a time on the movable bed (2) to be subsequently recognized individually or in a stacked manner as claimed above.

8. An automatic feeder for electrowelded metal nets including:

at least one conveyor bed means (2), the conveyor bed means (2) having a horizontal surface for supporting a pack (3) of stacked nets and being adapted for moving vertically and horizontally;

means adapted for recognizing the geometric orientation and/or the structural configuration of a net (4), the net (4) being arranged individually or stacked above the pack (3) of stacked nets,

means adapted for actuating automatically an arm (5) provided with suitable grip clamps (11), the arm (5) being adapted to handle the net (4) and to position the net (4) correctly on a net working machine or to place the net (4) on means (13) for turning the net (4) preferably up to 180°,

at least one upper beam means (10) extending above the net (4) stacked in the pack (3), the upper beam means (10) being adapted to support the means for recognizing the geometric orientation and/or the structural configuration

of a net, the means for recognizing the geometric orientation and/or the structural configuration of a net being adapted to communicate and actuate, by virtue of automation methods, the arm (5) with the grip clamps (11), and at least one separator means (14), the separator means (14) including one or more wedges which are capable of being inserted from an external position to a position within the stack (3) of nets.

9. The automatic feeder according to claim 8, **characterized in that** the means (13) for turning the net (4) includes at least one unit (13) for turning nets over through 180° from a horizontal position to an upside-down horizontal position, the unit (13) being made of a plurality of aligned supporting arms, which rotate simultaneously, are pivoted about the horizontal axis, are perpendicular to the work direction, and are provided with automatic clamps (15) for gripping the net (4) to be turned over.

10. The automatic feeder according to claim 8 or 9, **characterized by** further including means for coordinating the movement of a first upper net of the pack (3), a remaining part of the pack (3) and the separator means (14), such that when the first upper net of the pack (3) is kept raised by the arm (5) and the remaining part of the pack (3) is lowered, the separator means (14) is inserted between the lower surface of the first raised net and the upper surface of the remaining part of the pack (3).

11. The automatic feeder according to one or more of claims 8-10, **characterized in that** the upper beam means (10) is fixed and **in that** the means adapted for recognizing the geometric orientation and/or the structural configuration of the net (4) includes electromagnets (16) or the like, such as to releasably hold a first net in a raised position in respect to the remaining part of the pack (3) of stacked nets and to facilitate in insertion of the wedge of the separator means (14) between the first net and the remaining part of the pack (3).

12. A method for verifying and checking the presence of a net (4) in a pack (3) of stacked electrowelded metal nets, wherein the following steps are provided:

a) in the presence of a horizontal pack of electrowelded metal nets, stacked haphazardly (with different and/or identical adjacent surfaces) or stacked with the correct orientation (all with the same orientation) for the subsequent work (or also all stacked with the opposite orientation with respect to the orientation of the subsequent work), on the transfer bed (2),

which can move vertically and horizontally on command, the lateral ends of the nets are made to adhere and are aligned along a vertical plane that is perpendicular to the work advancement flow;

b) said pack of nets (3) is raised, by means of the transfer bed (2), until the upper gridlike surface of the first net at the top of the stacked pack adheres to, or approaches, the recognition devices (16) arranged on the lower part of the transverse beam (10);

c) once recognition of the structural geometry of the upper surface of the first net at the top of the pack has occurred, the corresponding devices actuate the automatic positioning of the overlying arm (5), which can move in three dimensions and is provided with appropriate grip clamps (11) for correctly locking the net on the lateral side (at right angles to the work flow); furthermore, once the orientation of the net has been recognized, the net is automatically either sent directly to the bending machine or other machine, or transferred onto the unit for turning over through 180°; at the same time, the lowering of the transfer bed that supports the pack of nets is actuated, leaving only the first gripped and identified net in a raised position;

d) at this point, the net separation unit (14) starts to operate, said unit being composed of multiple slender and aligned wedges, which move horizontally from a position that is external to the pack, penetrating between the suspended net (4) and the second net that lies on the lowered pack; from this moment, the recognized net can be transferred, by dragging with the arm (5) or to the overturning unit or can be arranged directly at the bending machines (8, 9) or others;

e) if the upper side of the recognized net is arranged opposite with respect to the optimum one provided for the subsequent work, said net is transferred and positioned onto overturning arms (13), which are equipped with appropriately provided clamps (15) or other equivalent systems, in order to rotate said net through 180° with respect to the side that is perpendicular to the work flow;

f) once rotation has been performed, the net is then arranged on the mutually opposite bending machines (8, 9), which are movable and are orientated at right angles with respect to the work flow; this is followed by activation of the vertical carriage (6) for the programmed operations for bending or other work, and of the carriage (7) for evacuating the finished products.

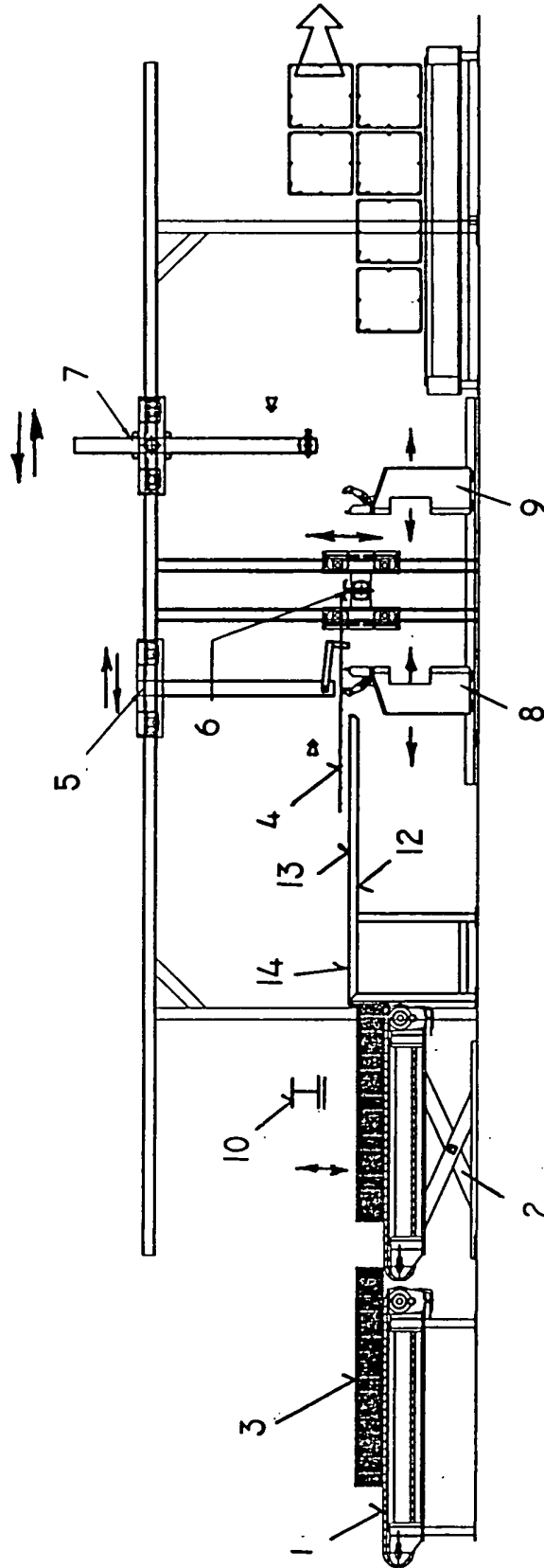
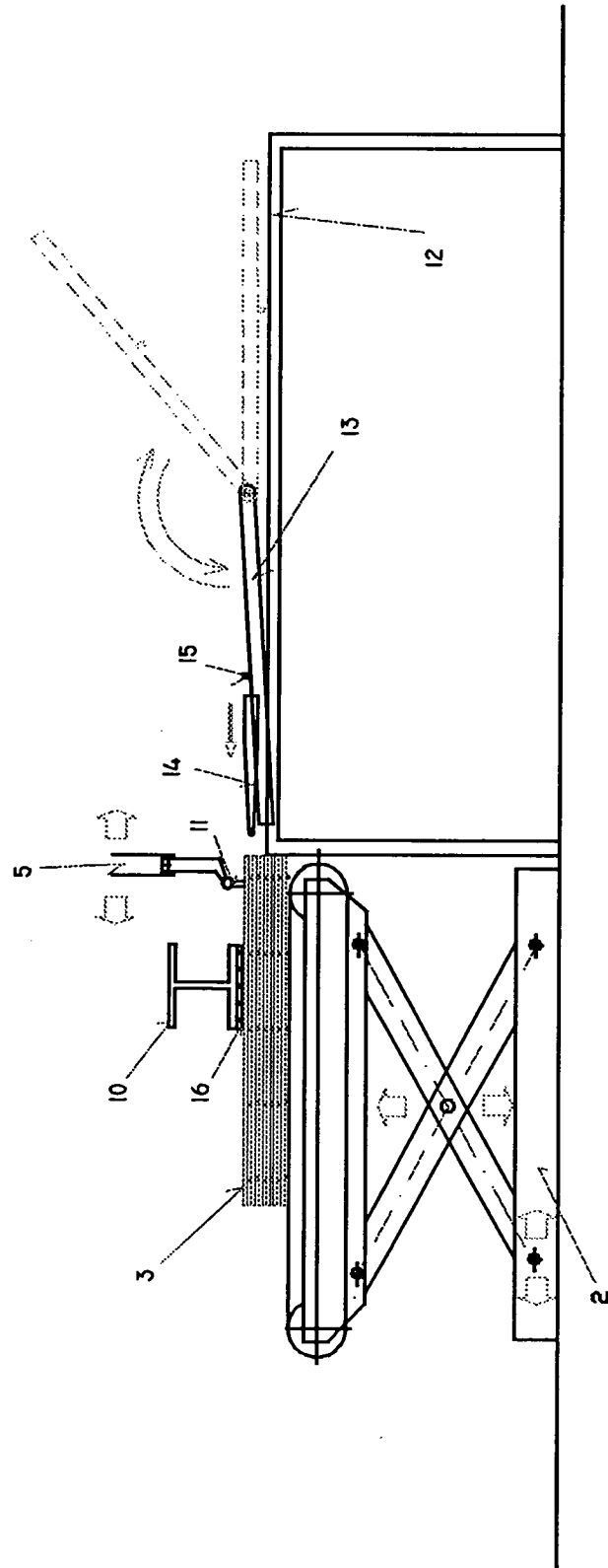


FIG. 1



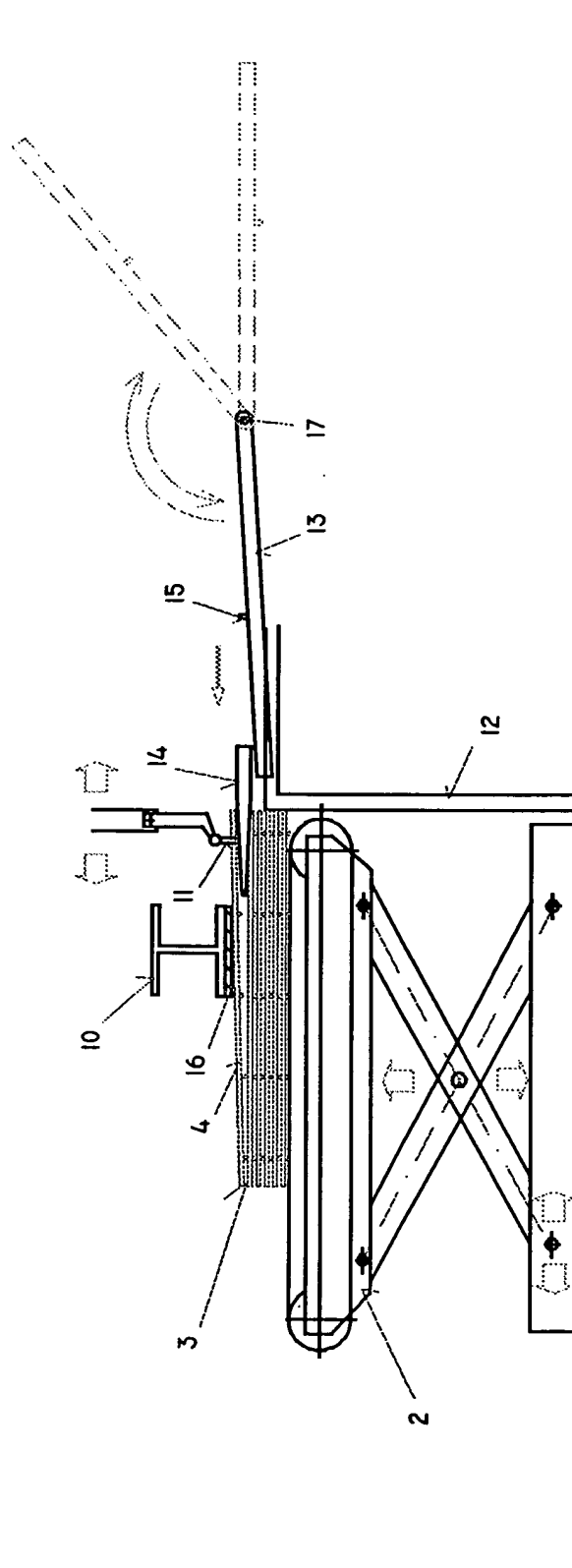


FIG. 3

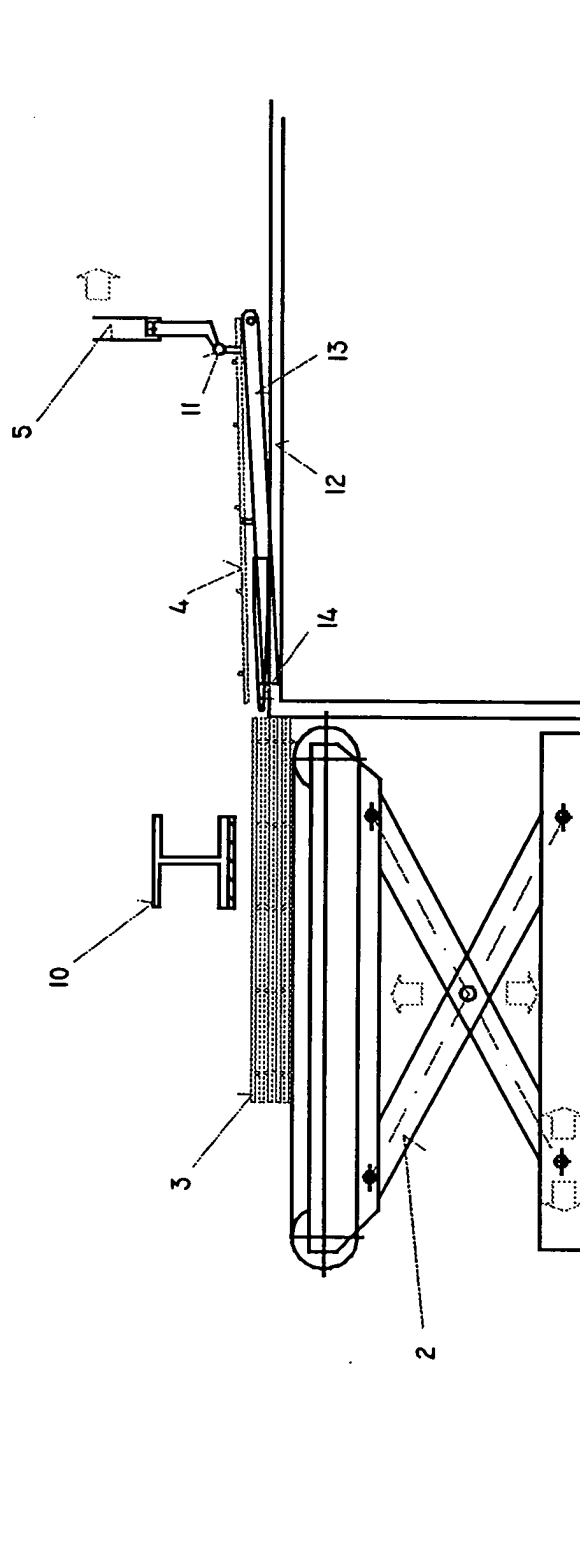


FIG. 4

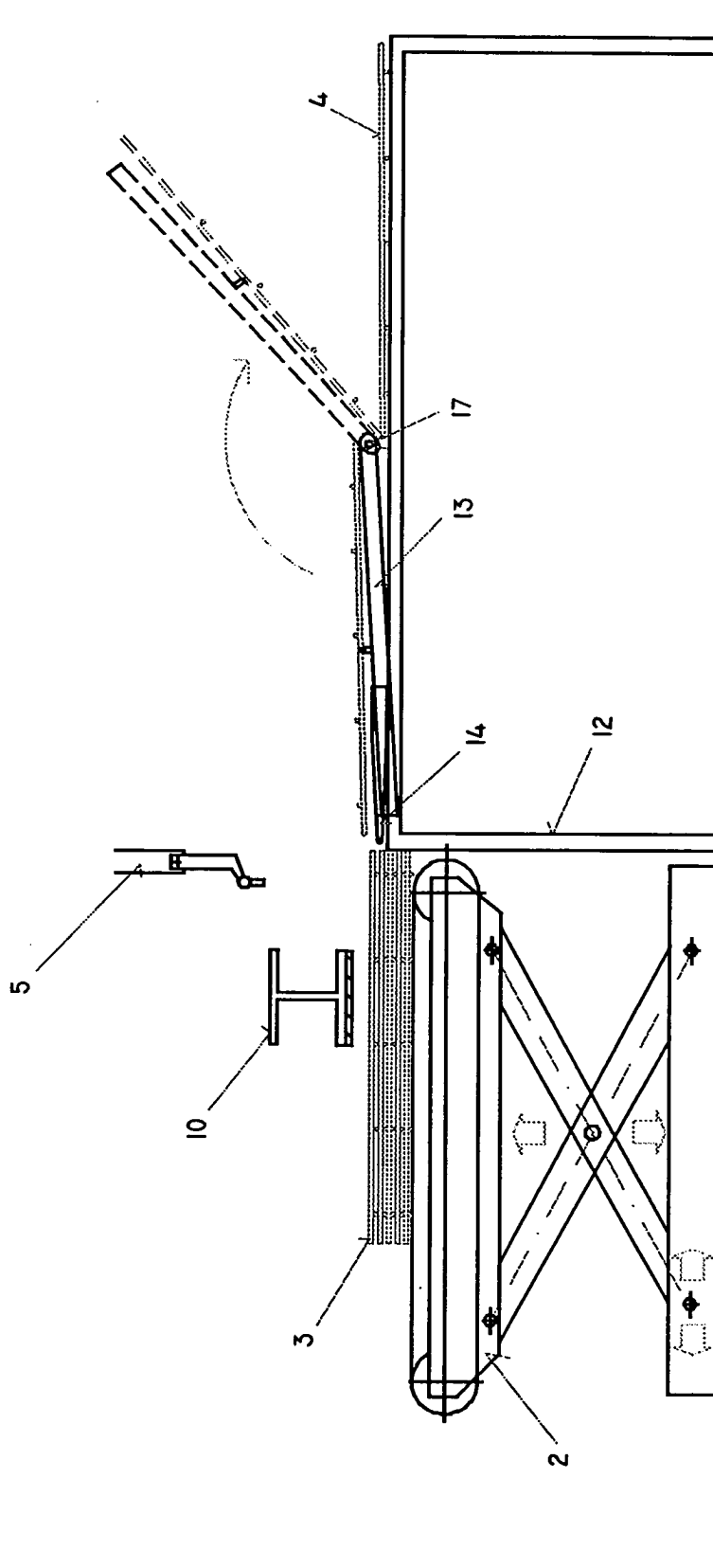


FIG. 5

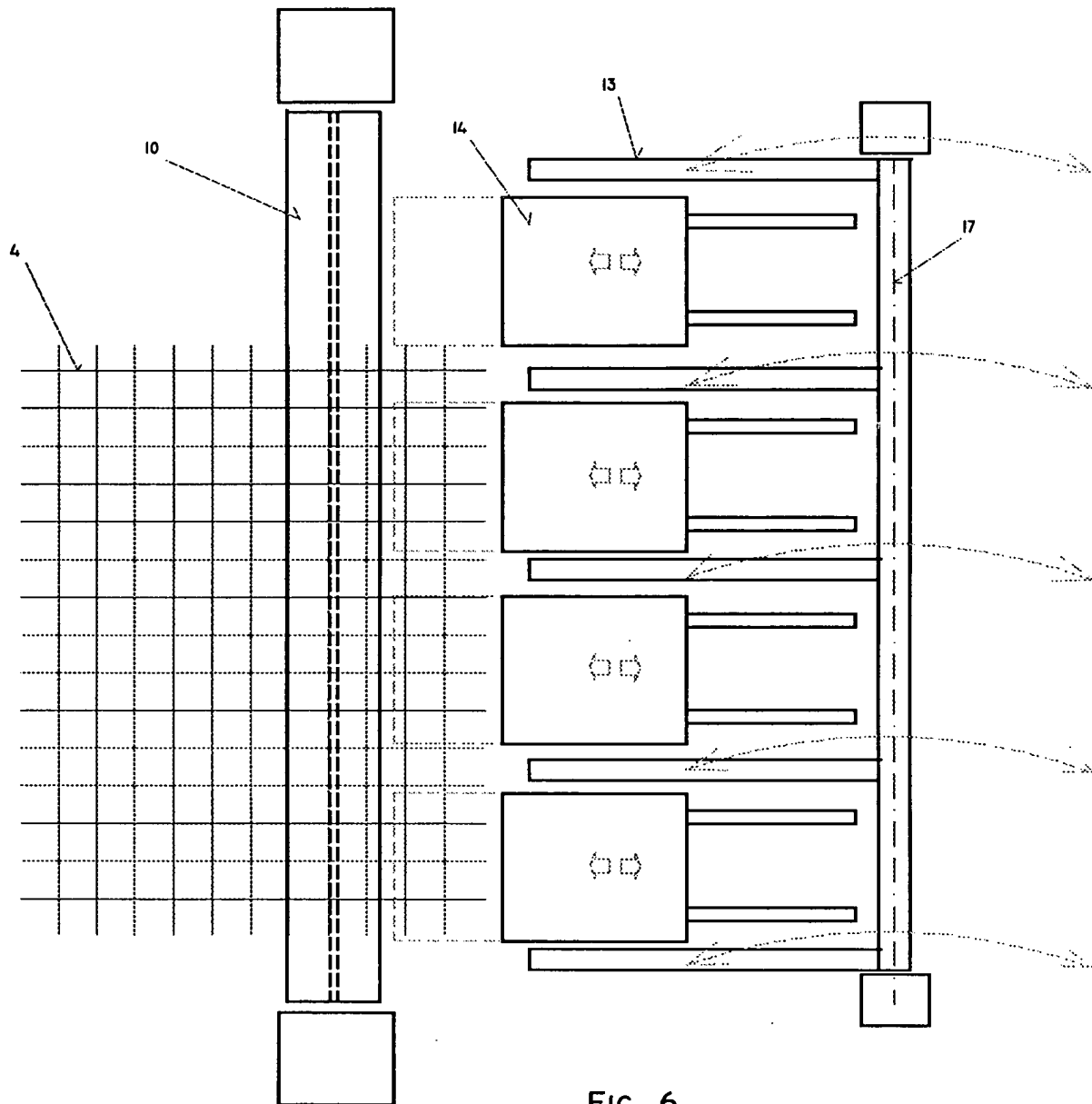


FIG. 6



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 02 4820

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 14 March 2005	Examiner Peeters, L
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			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 04 02 4820

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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