SYSTEM AND METHOD FOR INSTALLING A PROTECTIVE COVERING ONTO A STACK OF WORK PIECES

Inventors: Eldon Lee Owen, Eugene, OR (US); Asa Gray DeForest, Springfield, OR (US); Brian Keith Clark, Dexter, OR (US); Robert Elliott Pitts, Eugene, OR (US); Dwayne Alan Schwake, Eugene, OR (US)

Correspondence Address:
MARGER JOHNSON & MCCOLLM, P.C.
210 SW MORRISON STREET, SUITE 400
PORTLAND, OR 97204 (US)

Assignee: Willamette Valley Company, Eugene, OR (US)

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ABSTRACT

A system and method for installing a protective covering onto at least one substantially entire side portion of a stack of products. The system includes an apparatus for automatically, and preferably continuously, robotically moving, positioning and fastening a protective covering to at least one side portion of a stack of products. The side portions of the stack of products can vary in dimensions. The protective covering can also protect a top portion of the stack of products. The stack of products can include stacks of plywood, particleboard, OSB, lumber or other bundles of predetermined sizes.
FIG 6
SYSTEM AND METHOD FOR INSTALLING A PROTECTIVE COVERING ONTO A STACK OF WORK PIECES

RELATED APPLICATION

[0001] This is a divisional of U.S. patent application Ser. No. 11/051,249, filed on Feb. 3, 2005. Priority of application Ser. No. 11/051,249 is hereby claimed. The contents of application Ser. No. 11/051,249 are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] This invention relates to a system and method for installing a protective covering onto a stack of work pieces, and more particularly, for installing at least one protective covering capable of substantially covering at least one entire side portion of the stack of work pieces.

[0003] U.S. Pat. No. 3,271,925 relates to a machine which employs small bendable plates as edge protection for the use in combination with flexible strapping employed to wrap around a stack of work pieces to maintain the stack in an aligned pile. Other strapping and edge or corner protection application systems are provided in U.S. Pat. Nos. 3,271,925; 3,378,987; 3,585,780; 3,620,434; 3,995,409; 4,587,791; 4,700,530; 5,226,280; 5,289,668; 5,535,752; 5,564,254; 5,596,863; and 5,619,838. The following U.S. Patents relate to wrapping work pieces with wrapping materials such as polymeric films or sheets or shrink materials, hermetic bags, etc.: U.S. Pat. Nos. 4,106,394; 4,231,210; 5,657,608; 6,138,438; 6,161,365; 6,279,295; 6,371,292; 6,401,433; 6,460,314; and 6,505,728.

SUMMARY OF THE INVENTION

[0004] A system and method is provided for installing a protective covering onto at least one substantially entire side portion of a stack of products. The system comprises at least one protective covering capable of substantially covering at least one side portion, and preferably the entire side portion of the stack of products. Furthermore, the system includes an apparatus for automatically, and preferably continuously, robotically moving and positioning each the protective covering against at least one side portion of the stack of products, and for automatically, and preferably continuously, fastening each protective covering so that it is installed onto a side of the stack of products. Preferably, the apparatus for automatically fastening the protective covering comprises an apparatus for robotically fastening the protective covering.

[0005] The apparatus for automatically moving and positioning the protective covering preferably comprises a robotic mechanism. The robotic mechanism is preferably supported at a location above the stack of products. The robotic mechanism preferably comprises a robotic arm. Furthermore, the apparatus for automatically fastening the protective covering preferably comprises a robotic mechanism. The robotic mechanism is preferably supported at a location above the stack of products. The robotic mechanism preferably comprises a robotic arm.

[0006] The apparatus for fastening the protective covering preferably comprises a stapling apparatus. The apparatus for automatically moving and positioning the protective covering against the side portion of the stack of products preferably includes an electronic positioning device. The system can further includes a first device to interconnect the apparatus and the protective covering during the automatic moving and positioning of each the protective covering, and second device for fastening the protective covering to the stack of products. The apparatus preferably lifts the protective covering and then moves and positions it against the stack of products.

[0007] Unlike certain prior art devices which are limited to product stacks having a specific dimensional configuration, the side portions of the stack of products of this invention can comprise a plurality of dimensions. Preferably, the stack of products comprises a stack of lignocellulosic products. More preferably, the stack of products comprise plywood, particleboard, OSB, lumber stacks or bundles of predetermined size.

[0008] In the system of the present invention, a plurality of side portions of the stack of products are preferably overlaid by the protective coverings. Each of the protective coverings is preferably installed so as to wrap about the outer edges of the stack of products. Each of the protective covering can be preferably installed so as to wrap about the top of the stack of products. Moreover, the protective covering is preferably fabricated of a non-film material. Preferably, the protective covering is fabricated of a stiff, bendable material. More preferably, the protective covering comprises a cardboard-containing covering.

[0009] The system preferably includes a printing device connected to the robotic mechanism for imprinting indicia onto each the protective covering by inkjet, laser, ink roller or methods of printing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 is a perspective view of the robotic product wrapping system according to the invention.

[0011] FIG. 2 is a top plan view of the product wrapping system of FIG. 1.

[0012] FIG. 3 is a detailed perspective view of the product wrapping system of FIG. 1 showing a protective covering handling tool attached to a robotic arm.

[0013] FIG. 4 is a detailed perspective view of the product wrapping system of FIG. 1 showing a fastening tool attached to the robotic arm.

[0014] FIGS. 5A-5G are detailed perspective views of the product wrapping system of FIG. 1 illustrating a process of positioning and fastening a protective covering to a side of a stack of products.

[0015] FIG. 6 is a block diagram of a control system according to the invention.

DETAILED DESCRIPTION

[0016] Referring to FIGS. 1 and 2, a stack of products 22 is loaded onto product carrier 56 at a product load entrance 68 of the system 20 from which the product carrier 56 moves the stack 22 into the operating area 70 of system 20. The product carrier 56 is preferably a conveyor driven by a 7.5 hp motor and drive. The stack of products can be comprised of a stack of lignocellulosic products including, but not
limited to, plywood and particle board. The height of the stack of products 22 can be from about 16 to 38 inches. Typically, these stacks are either about 16 or 38 inches in height representing half packs and full packs of lignocellulosic product. The product itself is conventionally 4 feet wide and 8 feet long, with length being defined as the longitudinal direction parallel to the movement of the stack of products 22 on the product carrier 56. However, other products of differing dimensions can be accommodated by the system 20.

[0017] A protective covering 24 to be wrapped around the stack 22 is loaded in a stack on a hydraulic scissor lift 80 that is positioned to one side of the stack of products 22 that has been introduced into the operating area 70 of the system 20. The protective covering can be a non-film-like material, and is preferably fabricated of a stiff, bendable material with cardboard being a more preferable material. While the protective covering can be one of many materials, for the purposes of illustration, the protective covering and its related components will be referred to as cardboard hereinafter in this description.

[0018] Stacks of cardboard 24 can be loaded into the system 20 on a delivery system 52. The delivery system 52 provides two loading areas 66, one on each side of the scissor lift 80. A cardboard stack conveyor 40 in the delivery system 52 loads a stack of cardboard 24 onto the scissor lift 80. The conveyor 40 reverses direction to load a stack of cardboard 24 from the other side of the scissor lift 80.

[0019] The product wrapping system 20 utilizes a robotic arm 26 located above the stack of products 22 in operating area 70 on support 42. A computerized controller 58 controls the robotic arm 26. In FIGS. 1 and 2, the robotic arm 26 is a Motoman UP50-35 robot and the computerized controller 58 is a Motoman NX 100 controller. The robotic arm can be any six-axis robot with the appropriate reach and torque requirements and the computerized controller can be any suitable 6-axis robotic controller device. The robotic arm 26 has been programmed to remove cardboard sheets 24 from the hydraulic scissor lift 80 using a cardboard handling tool 28 (shown in FIG. 3). Move the sheet into an installation position, and then automatically wrap and staple the cardboard 24 onto the stack 22 utilizing a fastening tool 32 (shown in FIG. 4). The height, width, and stopping position of stack 22 within the system 20 are monitored by the controller 58 to allow the robotic arm 26 to automatically adjust placement and stapling positions based on load dimensions and stopped position of the load on the product carrier 56. After the cardboard 24 is fastened to the stack of products 22, the product carrier 56 transports that stack through the system to the product load exit 74 and moves the next stack of products 22 from the product load entrance 68 to the operating area 70 of the system 20. These steps are repeated to provide automatic wrapping and fastening of cardboard 24 to consecutive stacks of products 22.

[0020] The robotic arm 26 handles sheets of cardboard 24 through the use of a detachable cardboard handling tool 28 which utilizes pneumatic vacuum assist to handle the cardboard 24 (shown in FIG. 3). The robotic arm 26 wraps and fastens the cardboard 24 to the stack of products 22 through the use of a detachable fastening tool 32 (shown in FIG. 4). The system 20 also includes an automatic staple supply delivery system 54 that is used to automatically reload the fastening tool 32 when the fastening tool 32 runs out of staples.

[0021] The perimeter guard fence 38 encloses the product wrapping system 20 while providing interlocked access points. An example of these access points are: a unidirectional safety monitored product load entrance 68, a unidirectional safety monitored product load exit 74, operating area access doors 82 to allow personnel entry, and safety monitored cardboard loading zones 66. The guard fence 38 in FIGS. 1 and 2 is made of connected sections of steel grating, though other forms of fencing could be used. The perimeter guard fence 38 is configured to ensure manufacturing personnel are unable to come in contact with the robot or system components during operations by stopping and inhibiting the robot arm 26, peripheral component motion, and pneumatic power if a safety circuit has been interrupted in an unsafe operational condition such as an operator or other person attempting to enter the operation area while the system 20 is in the process of positioning or stapling cardboard 24 to a stack of products 22.

[0022] The operating access doors 82 are interlocked with the system such that opening an access door 82 will stop and inhibit robot, conveyor, scissor lift, and pneumatic component operation. The interlock can be overridden to allow for operation of the robotic arm 26 in a "teach" mode or operation of the entire system 20 in a "teach" mode. The product load entrance 68 and exit 74 are monitored by unidirectional safety monitoring systems that sense whether an appropriate load is entering or exiting the perimeter guard fencing 38. If the monitoring sensors sense anything other than an appropriate load entering or exiting during normal operation, the safety system will prohibit operation of the robotic arm 26 and the product carrier 56. The cardboard loading zone 66 has safety light curtains that prevent improper loading or entry by personnel by shutting down the operation of the conveyor that is part of the cardboard delivery system 52.

[0023] Referring to FIG. 3, the robotic arm 26 is mounted on supports 42 such that the robotic arm 26 is positioned above the stack of products 22 in the operating area 70. In FIG. 3, the cardboard handling tool 28 is attached to the end of the robotic arm 26. The robotic arm 26 maneuvers the detachable cardboard handling tool 28 to pick up, move, and position a piece of cardboard 24 against the side of a stack of products 22. The cardboard handling tool 28 is pneumatically and electrically connected to the end of the robotic arm 26. The pneumatic connection allows the tool 28 to pneumatically pick up the cardboard 24 by means of the vacuum cups 62. The cardboard handling tool 28 is custom-designed for use in the system 20 but utilizes some standard products as components. For example, the vacuum cups 62 in FIG. 3 are VI-Cas Style N Vacuum Cups referenced as Willamette Valley Co. component part number 5442-04-90-2002. The cardboard handling tool 28 in FIG. 3 attaches to the robotic arm 26 and operates by means of a QC-41 Tool Plate and a QC-41 R19 Tool Electrical Module, referenced as Willamette Valley Company component numbers 5442-01-90-2016 and 5442-01-90-2027, respectively.

[0024] FIG. 4 shows the robotic arm 26 with the detachable fastening tool 32 attached to the end of the robotic arm 26. The fastening tool 32 is pneumatically and electrically
connected to the robotic arm 26. The connection allows control of movement of the fastening tool 32 on fastener slide 76, independent of the movement of robotic arm 26. The connection also allows for controlling a stapler 78 on the fastening module 32. The fastening tool 32 is custom designed for use in the system 20 wherein the custom design includes flap pusher 84 that allows the fastening tool 32 to push a flap of cardboard 24 around an edge of a stack of products 22 (shown in FIGS. 6B and 6C). In FIG. 4, the stapler 74 is a robotic stapler gun referenced by Willamette Valley Company component number 5410300 and the fastening tool 32 attaches to the robotic arm 26 utilizing the same QC-41 Tool Plate and QC-41 R19 Tool Electrical Module as used on the cardboard handling tool 28.

[0025] FIGS. 5A-5G are detailed perspectives views of the product wrapping system 20 illustrating a process of positioning and fastening a piece of cardboard 24 onto one side of a stack of products 22.

[0026] FIG. 5A is a detailed perspective view of the product wrapping system 20 showing the piece of cardboard 24 being positioned against one side of the stack of products 22. The cardboard 24 is positioned against the side of the stack of products 22 by the robotic arm 26 using the cardboard handling tool 28. The robotic arm 26 pneumatically attaches the cardboard 24 to the cardboard handling tool 28 and presses the cardboard 24 flat against the side of the stack of products 22.

[0027] In FIG. 5B, the arms of the electronic positioning devices 30 are then extended toward the cardboard 24 to retain the cardboard 24 pressed against the side of the stack of products 22 after the cardboard handling tool 28 is detached and retracted from the cardboard 24. The electronic positioning devices 30 are left and right hand cardboard retainers referenced by Willamette Valley Company component numbers 5443-03-11-2001 and 5443-03-11-2000, respectively. The top portion 40 of the cardboard 24 is shown in FIG. 5B extending beyond the top edge of the stack of products 22. The side portions 42 and 44 of the cardboard 24 are also shown extending beyond the front and back sides of the stack of products 22.

[0028] FIG. 5C is a detailed perspective view of the product wrapping system 20 showing the side portion 42 of cardboard 24 being bent around the front edge of the stack of products 22 by the flap pusher 84 on the fastening tool 32 on the end of the robotic arm 26. The side portion 42 of cardboard 24 wrapped around the front edge of the stack of products 22 is stapled to the front edge of the stack of products 22 using the fastening tool 32 by activating stapler 78. The cardboard 24 can also be fastened to the side of the stack of products 22 by stapling the cardboard to the side of the stack of products 22 prior to bending and stapling of portions 42 and 44 of the cardboard 24.

[0029] FIG. 5D shows flap 46 on side portion 42 being bent down onto the top of the stack of products 22. The fastening tool 32 then staples flap 46 to the top of the stack of products 22.

[0030] FIG. 5E shows the process being repeated for side portion 44 of cardboard 24 extending beyond the back edge of the stack of products 22. FIG. 5F shows flap 48 on side portion 44 being bent down onto the top of the stack of products 22 and being stapled by activating the stapler 78.

[0031] FIG. 5G shows top portion 40 of the cardboard 24 being bent down onto the top of the stack of products 22. The fastening tool 32 then staples the top portion 40 to the top of the stack of products 22.

[0032] The positioning and fastening process is then repeated with another piece of cardboard 24 that is positioned and fastened to the opposite side of the stack of products 22.

[0033] FIG. 7 is a block diagram of an exemplary control system as may be utilized in embodiments of the invention. The invention is not limited to a single computing environment. Moreover, the architecture and functionality of the invention as taught herein and as would be understood by one skilled in the art is extensible to other types of computing environments and embodiments in keeping with the scope and spirit of the invention. The invention provides for various methods, computer-readable mediums containing computer-executable instructions, and apparatus. With this in mind, the embodiments discussed herein should not be taken as limiting the scope of the invention; rather, the invention contemplates all embodiments as may come within the scope of the appended claims.

[0034] The present invention includes various operations, which will be described below. The operations, may be performed by hard-wired hardware, or may be embodied in machine-executable instructions that may be used to cause a general purpose or special purpose processor, or logic circuits programmed with the instructions to perform the operations. Alternatively, the operations may be performed by any combination of hard-wired hardware, and software driven hardware.

[0035] The present invention may be provided as a computer program product that may include a machine-readable medium, stored thereon instructions, which may be used to program a computer (or other programmable devices) to perform a series of operations according to the present invention. The machine-readable medium may include, but is not limited to, floppy diskettes, optical disks, CD-ROM's, DVD's, magneto-optical disks, ROM's, RAM's, EPROM's, EEPROM's, hard drives, magnetic or optical cards, flash memory, or any other medium suitable for storing electronic instructions. Moreover, the present invention may also be downloaded as a computer software product, wherein the software may be transferred between programmable devices by data signals in a carrier wave or other propagation medium via a communication link (e.g. a modem or a network connection).

[0036] FIG. 7 illustrates an exemplary control system 400 upon which embodiments of the invention may be implemented. For example, an apparatus comprising a machine-readable medium may contain instructions that, when executed, cause a machine to provide a stack of products having a plurality of side portions, provide at least one protective covering capable of substantially covering at least one side portion of the stack of products, position each protective covering against at least one side portion of the stack of products, and fasten each protective covering so that it is installed onto a side of the stack of products. An embodiment may include an apparatus further comprising instructions that, when executed, cause a machine to overlay a plurality of side portions of the stack of products without substantially moving or rotating the stack of products. An
embodiment apparatus may further comprise instructions that cause a machine to staple the protective covering to the stack of products. Additionally, an apparatus may comprise instructions that cause a machine to install protective coverings on at least a pair of opposite sides of the stack of products. Another example apparatus may further comprise instructions that cause a machine to bendably install the protective covering around edges of the stack of products.

[0037] In FIG. 7, control system 400 comprises a bus or other communication means 401 for communicating information, and a processing means such as processor 402 coupled with bus 401 for processing information. Control system 400 further comprises a random access memory (RAM) or other dynamically-generated storage device 404 (referred to as main memory), coupled to bus 401 for storing information and instructions to be executed by processor 402. Main memory 404 also may be used for storing temporary variables or other intermediate information during execution of instructions by processor 402. Control system 400 also comprises a read only memory (ROM) and/or other static storage device 406 coupled to bus 401 for storing static information and instructions for processor 402.

[0038] A data storage device 407 such as a magnetic disk or optical disk and its corresponding drive may also be coupled to control system 400 for storing information and instructions. Control system 400 can also be coupled via bus 401 to a display device 421, such as a cathode ray tube (CRT) or Liquid Crystal Display (LCD), for displaying information to an end user. Typically, an alphanumeric input device (keyboard) 422, including alphanumeric and other keys, may be coupled to bus 401 for communicating information and/or command selections to processor 402. Another type of user input device is a cursor control 423, such as a mouse, a trackball, or a cursor direction keys for communicating direction information and command selections to processor 402 and for controlling cursor movement on display 421.

[0039] A communication device 425 is also coupled to bus 401. The communication device 425 may include a modem, a network interface card, or other well-known interface devices, such as those used for connecting to Ethernet, token ring, or other types of physical attachment for purposes of providing a communication link to support a local or wide area network, for example. In this manner, the control system 400 may be networked with a number of clients, servers, or other information devices.

[0040] It is appreciated that a lesser or more equipped computer system than the example described above may be desirable for certain implementations. Therefore, the configuration of control system 400 will vary from implementation to implementation depending upon numerous factors, such as price constraints, performance requirements, technological improvements, and/or other circumstances.

[0041] Although a programmed processor, such as processor 402 may perform the operations described herein, in alternative embodiments, the operations may be fully or partially implemented by any programmable or hard-coded logic, such as Field Programmable Gate Arrays (FPGAs), TTL logic, or Application Specific Integrated Circuits (ASICS), for example. Additionally, the method of the present invention may be performed by any combination of programmed general-purpose computer components and/or custom hardware components. Therefore, nothing disclosed herein should be construed as limiting the present invention to a particular embodiment wherein the recited operations are performed by a specific combination of hardware components.

[0042] Having described and illustrated the principles of the invention in a preferred embodiment thereof, it should be apparent that the invention can be modified in arrangement and detail without departing from such principles. I claim all modifications and variation coming within the spirit and scope of the following claims.

1. A system for installing a protective covering onto at least one substantially entire side portion of a stack of products, which comprises: at least one protective covering capable of substantially covering at least one side portion of said stack of products; and
an apparatus for automatically and robotically moving and positioning said protective covering against at least one side portion of said stack of products, and for automatically and continuously fastening each said protective covering so that it is installed onto a side of said stack of products.

2. The system of claim 1, the apparatus further including automatically and continuously providing a next stack of products for installing a protective covering.

3. The system of claim 1, wherein the apparatus for automatically fastening said protective covering comprises an apparatus for robotically fastening said protective covering.

4. The system of claim 1, wherein the apparatus for automatically moving and positioning said protective covering comprises a robotic mechanism.

5. The system of claim 3, wherein the apparatus for automatically fastening said protective covering comprises a robotic mechanism.

6. The system of claim 4, wherein the robotic mechanism comprises a robotic arm.

7. The system of claim 5, wherein the robotic mechanism comprises a robotic arm.

8. The system of claim 3, wherein said protective covering comprises a cardboard-containing covering.

9. The system of claim 1, wherein said side portions of said stack of products can comprise a plurality of dimensions.

10. The system of claim 1, wherein a plurality of side portions of said stack of products are overlaid by the protective coverings.

11. The system of claim 1, wherein the stack of products comprises a stack of lignocellulosic products.

12. The system of claim 1, wherein said fastening step comprises stapling.

13. The system of claim 1, wherein the apparatus for automatically moving and positioning said protective covering against the side portion of said stack of products includes an electronic positioning device.

14. The system of claim 4, wherein said robotic mechanism is supported at a location above the stack of products.

15. The system of claim 5, wherein said robotic mechanism is supported at a location above the stack of products.

16. The system of claim 1, wherein the products comprise plywood or particleboard.

17. The system of claim 1, which further includes a first device to interconnect the apparatus and the protective
covering during the automatic moving and positioning of each said protective covering, and second device for fastening said protective covering to said stack of products.

18. The system of claim 1, wherein each said protective covering is installed so as to wrap about the outer edges of the stack of products.

19. The system of claim 1, wherein each said protective covering is installed so as to wrap about the top of the stack of products.

20. The system of claim 1, wherein said protective covering is fabricated of a non-film material.

21. The system of claim 1, wherein said protective covering is fabricated of a stiff, bendable material.

22. The system of claim 1, wherein said apparatus lifts said protective covering and then moves and positions it against the said of the stack of products.

23. The system of claim 1, which further includes a printing device connected to said robotic mechanism for imprinting indicia onto each said protective covering.

24. The system of claim 1, further comprising a safety barrier surrounding the apparatus.

25. The system of claim 24, wherein the safety barrier includes:
an opening for delivering a stack of products to the apparatus; and

an opening for receiving a stack of products from the apparatus.

26. The system of claim 25, wherein the safety barrier further includes an opening for delivering a protective covering to the apparatus.

27. The system of claim 25, wherein the safety barrier further includes an opening for delivering fasteners to the apparatus.

28. The system of claim 25, wherein the safety barrier further includes at least one access door for providing a human operator access to the apparatus.

29. The system of claim 28, wherein the at least one access door is equipped with a safety interlock.

30. The system of claim 29, wherein the safety interlock engages when the at least one access door is opened and the safety interlock stops the apparatus.

31. The system of claim 25, wherein the openings for delivering and receiving a stack of products are safety monitored.

32. The system of claim 25, wherein the opening for delivering a protective covering is safety monitored.

33. The system of claim 24 wherein the safety barrier is a perimeter guard fence.

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