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(54) **WINDING MACHINE FOR RAFFIA SPOOLS**

(57) The present invention relates to a winding machine for raffia spools intended for obtaining individual spools of a pre-set length starting from a large-volume feed spool. The machine is capable of assembling the two parts that form each spool and subsequently winding the specific number of metres that are preselected. Once the winding process is finished, the machine cuts the rope and secures it to prevent the yarn spool from unravelling to subsequently start a new cycle with a new reel, all in a fully automated manner.

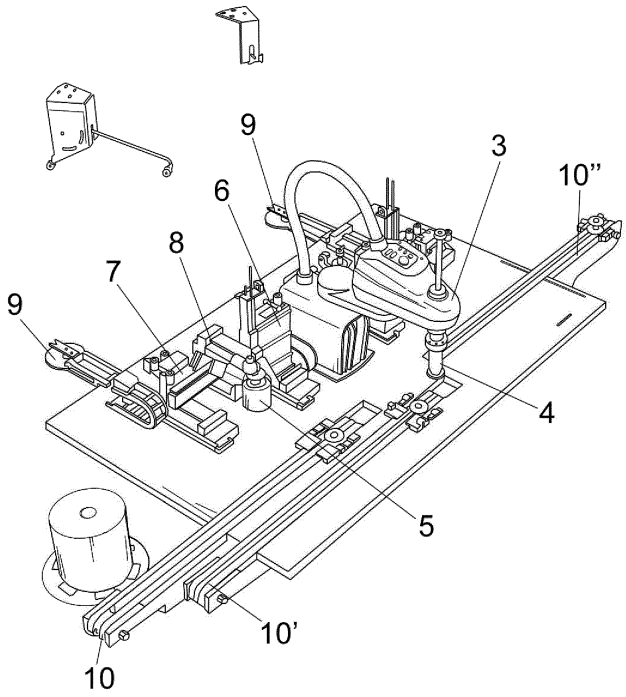

FIG. 2

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a winding machine for raffia spools which is designed to produce individual spools of a predetermined length from a large-volume feed spool.

[0002] The object of the invention is to enable a machine to perform the winding process in a completely autonomous and highly productive way - including the assembly of both parts of every reel, the winding of predetermined lengths on the reel, and the cutting and stabilisation of the strand - while precisely controlling the length wound per reel, minimising idle time and maximising productivity.

BACKGROUND OF THE INVENTION

[0003] While some phases of the process hitherto used to produce raffia spools have been automated, others have been carried out manually. As such, no existing machine is known to perform the entire process automatically, from start to finish, from the assembly of the reels to the winding of predetermined raffia strand lengths, and the cutting and stabilisation of the strand to ensure that the reel maintains its form.

SUMMARY OF THE INVENTION

[0004] The winding machine for raffia spools represents a perfectly adequate solution to the problem considered above, in so far as it automates the entire process of producing raffia spools from start to finish.

[0005] To this end, the machine to which the invention relates consists of a winding station support bench which includes a perimeter safety enclosure, wherein a series of sub-stations act to automate the entire process.

[0006] Specifically, the machine is fitted with a pair of conveyor belts on which the body and cap of the reel are respectively fed into the machine.

[0007] The belts transport the aforementioned parts to an area where a 4-axis robot handles not only both parts of the spool, but also the spool unit onto which thread has already been wound.

[0008] Their function is to ensure that parts are supplied to, and unloaded from, the winding stations, in sync with all the components of the machine.

[0009] As such, the machine is fitted with a spool gripper, or a gripping system, consisting of a 4-finger self-centring gripper that is powered pneumatically to guarantee rapid opening and closing manoeuvres.

[0010] A winding head in close proximity to this sub-station rotates the spool to wind the thread onto the spool.

[0011] It also ensures that the spool body is in the correct position by deploying a mechanism on its upper section to locate the pins of the spool and place it in a specific position for the purpose of attaching the cap.

[0012] Several functions are performed by a support centring system located to the side of the winding head. Once the robot has placed the spool cap on top of the winding head, the support centring system exerts the pressure required to force the cap into the spool body and securely fasten it. As this function is being performed, the robot is free to continue with its cycle.

[0013] Once the cap has been fastened to the spool body, it is maintained by applying pressure to keep the spool stable during the winding cycle.

[0014] As the centring system can be manoeuvred electronically within the operating zone, it can be extracted to give the robot access, on the one hand, and to enable the previously wound spool to be removed, on the other.

[0015] Another sub-station of the machine to which the invention relates is a thread handling sub-station, consisting of 3 pneumatic shafts and a further two pneumatic actuators, whose function is to jam, cut and position the thread correctly when one spool is finished and the processing of another is about to begin.

[0016] In this respect, the thread is guided towards the spool via a guiding sub-station whose function is to correctly guide the thread towards the spool in order to guarantee a parallel, orderly and uniform winding process.

[0017] The main reel or feed reel, also located within the machine, will securely direct the thread to the thread guide unit.

[0018] Finally, the finished spools are discharged via a third conveyor belt, at which point they reach a station for finished parts.

[0019] To increase the machine's productivity, the unit consisting of the feed reel, thread handler, thread guide, winding head and support centring system is duplicated in the machine, meaning that there is a unit arranged on either side of the handling robot.

[0020] As such, it is possible to automate the entire spool production process based on a system which precisely controls the length wound per spool, minimises idle time and maximises productivity.

DESCRIPTION OF THE DRAWINGS

[0021] To complement the following description and in order to facilitate a better understanding of the characteristics of the invention, in accordance with a preferred example of practical realisation, a series of drawings in which the following have been represented in a way that is illustrative and not limiting, is attached as an integral part of this description:

Figure 1 shows a perspective view of a winding machine for raffia spools in accordance with the object of the present invention.

Figure 2 shows a detail perspective view of the various sub-stations that make up the internal structure of the machine.

PREFERRED EMBODIMENT OF THE INVENTION

[0022] The figures above show that the winding machine for raffia spools to which the invention relates consists of a bench (1) which supports and sustains the aluminium base plate on which the various sub-stations of the winding machine are located. Housed within is a pneumatic control box with an air filtration system and a solenoid valve set used to control the pneumatic actuators. Moreover, all the wiring of the motors and pneumatic actuators is concealed within.

[0023] The bench (1) includes a perimeter safety enclosure (2) whose function is to prevent the operator from coming into contact with moving parts, and thereby to protect the operator from the risk of entrapment or bruising.

[0024] The enclosure in question (2) provides access to the operating zone via four points which are duly protected by safety sensors which activate the machine's emergency mode if opened. This structure includes LED lighting to indicate the operating zone. There are two enclosed spaces at the rear where the feed reels (9) are located; access doors are available for the purpose of replacing thread feed reels. In a central position to the rear, there is an electric cabinet from where the machine's power supply is monitored and controlled. A control board with a touch screen, buttons and emergency stop button is located on the front right-hand side.

[0025] As indicated above, the machine is fitted with a pair of conveyor belts (10-10'), on which the body and cap of the spool are respectively fed into the machine, and a conveyor belt (10") on which finished spools are discharged.

[0026] The belts are activated by a stepper motor connected to a reduction transmission, which drives the belts. These synthetic-compound belts are centred by positioning rails, so much so that, when their path ends at a receiving station, they are held, by mechanical means and/or by photocells, in a waiting position pending collection, while the feed belts are activated to maintain the input of parts.

[0027] The conveyor belts (10-10') transport the aforementioned parts to an area where a 4-axis robot (3) handles not only both parts of the spool, but also the spool unit onto which thread has already been wound.

[0028] Their function is to ensure that parts are supplied to, and unloaded from, two winding stations (5), in sync with all the components of the machine.

[0029] Thus, two units - consisting of a winding station (5), a feed reel (9), a thread handler (7), a thread guide (8) and a support centring system (6) - are located on both sides of the 4-axis robot (3) in order to increase the machine's productivity.

[0030] The 4-axis robot (3) is fitted with a spool gripper (4), or a gripping system, consisting of a 4-finger self-centring gripper that is powered pneumatically to guarantee rapid opening and closing manoeuvres. The 4-fingered gripping device is in turn fitted with "nails" to optimise "grip" efficiency according to the geometry of the spool, on the one hand, and to handle the parts at high acceleration, on the other.

[0031] Thus, reeling stations (5) are located on both sides of the 4-axis robot (3) to rotate the spool so that the thread is wound onto the spool by way of a servomotor.

[0032] They also ensure that the spool body is in the correct position by deploying a mechanism on their upper section to locate the pins of the spool and place it in a specific position for the purpose of attaching the cap. Two fibre optic photocells detect whether the spool has been placed in an incorrect position, while two angular contact bearings bear the pressure exerted by the support centring system (6).

[0033] Several functions are performed by a support centring system (6) simultaneously to the function of this mechanism. Once the robot has placed the spool cap on top of the winding head, the support centring system exerts the pressure required to force the cap into the spool body and securely fasten it. As this function is being performed, the robot is free to continue with its cycle.

[0034] Once the cap has been fastened to the spool body, it is maintained by applying pressure to keep the spool stable during the winding cycle. This system is installed on a linear table with a guiding system and double-acting pneumatic actuator which extracts the entire centring system to give the robot access, on the one hand, and to enable the previously wound spool to be removed, on the other.

[0035] As indicated above, the raffia strand is supplied by feed reels (9) whose function is to securely direct the thread towards the thread guide unit (8).

[0036] By way of example, these reels may weigh 5Kg since they include a mechanical catcher to prevent knots in the system, and an inductive sensor that shuts down the machine if a knot-induced jam is detected.

[0037] The reel includes a compensator system whose function is to absorb any tension peaks that may arise during the winding process.

[0038] Thus, the reels direct the thread towards the thread guide unit (8) where it is, in turn, correctly guided towards the spool in order to guarantee a parallel, orderly and uniform winding process.

[0039] It is composed of a servomotor with an attached ball screw system that transforms the rotation of the motor into a linear motion. This motion is followed by the thread and transferred to the winding process in the spool.

[0040] It also integrates an adjustable tension system for the purpose of setting the spool tension at a specific level.

[0041] The thread guide unit (8) in turn feeds a thread handling unit (7) consisting of 3 pneumatic shafts and a further two pneumatic actuators, whose function is to jam, cut and position the thread correctly when one spool is finished and the processing of another is about to begin.

[0042] Finally, the finished spools are discharged via

the third conveyor belt (10"), at which point they reach a station for finished parts.

Claims

1. Winding machine for raffia spools, consisting of a bench (1), which supports a base plate on which the various sub-stations of the machine are located, a bench (1) fitted with a perimeter safety enclosure (2), a machine with a pair of conveyor belts (10-10') on which the body and cap of the spool are respectively fed into the machine, and a conveyor belt (10") on which finished spools are discharged; the area where they are discharged by the conveyor belts (10-10') contains a 4-axis robot (3) with the means to handle both the two parts of the spool, and the spool unit onto which thread has previously been wound; the robot is fitted with a reel gripper (40 and has, on both sides, a winding station (5), a support centring system (6), a feed reel (9), a thread handler (7) and a thread guide (8), wherein

   a) the winding stations (5) include the means to receive and rotate the body of the spool;
   b) the support centring system (6) includes the means to exert pressure on, and consequently attach, the cap to the body of the spool, and the means to manoeuvre horizontally over the operating area;
   c) the feed reels (9) supply the thread guide unit (8);
   d) the thread guide unit (8) includes the means to guide the thread towards the spool;
   e) the thread guide unit (8) supplies a thread handling unit (7) consisting of 3 pneumatic shafts and a further two pneumatic actuators, including the means to jam, cut and position the thread.

2. Winding machine for raffia spools, according to claim 1, **characterised in that** housed within the bench (1) is a pneumatic control box with an air filtration system and a solenoid valve set used to control the pneumatic actuators of the various sub-stations of the machine.

3. Winding machine for raffia spools, according to claim 1, **characterised in that** the enclosure (2) provides access to the operating zone via four points which are duly protected by safety sensors which activate the machine's emergency mode if opened, including LED lighting to indicate the operating zone and two spaces in which the feed reels (9) are located, with access doors, an electric cabinet from where the machine's power supply is monitored and controlled, and a control board with a touch screen, buttons and emergency stop button.

4. Winding machine for raffia spools, according to claim 1, **characterised in that** the conveyor belts (10,10') are activated by a stepper motor connected to a reduction transmission, so much so that, when their path ends at a receiving station, their waiting position is detected for collection, and the feed belts are activated to maintain the input of parts.

5. Winding machine for raffia spools, according to claim 1, **characterised in that** the 4-axis robot (3) is fitted with a spool gripper (4), or a gripping system, consisting of a 4-finger self-centring gripper that is powered pneumatically.

6. Winding machine for raffia spools, according to claim 1, **characterised in that** the winding station (5) deploys a mechanism on its upper section to position the cap of the spool, and has the means to determine whether the cap has been positioned correctly.

7. Winding machine for raffia spools, according to claim 1, **characterised in that** the feed reels (9) include a mechanical catcher to prevent knots in the system, and an inductive sensor that shuts down the machine if a knot-induced jam is detected, including a compensator system whose function is to absorb peak tension on the thread.

8. Winding machine for raffia spools, according to claim 1, **characterised in that** the thread guide unit (8) includes a servomotor with an attached ball screw system that transforms the rotation of the motor into a linear motion, and a system whose function is to adjust the tension of the thread to be wound.

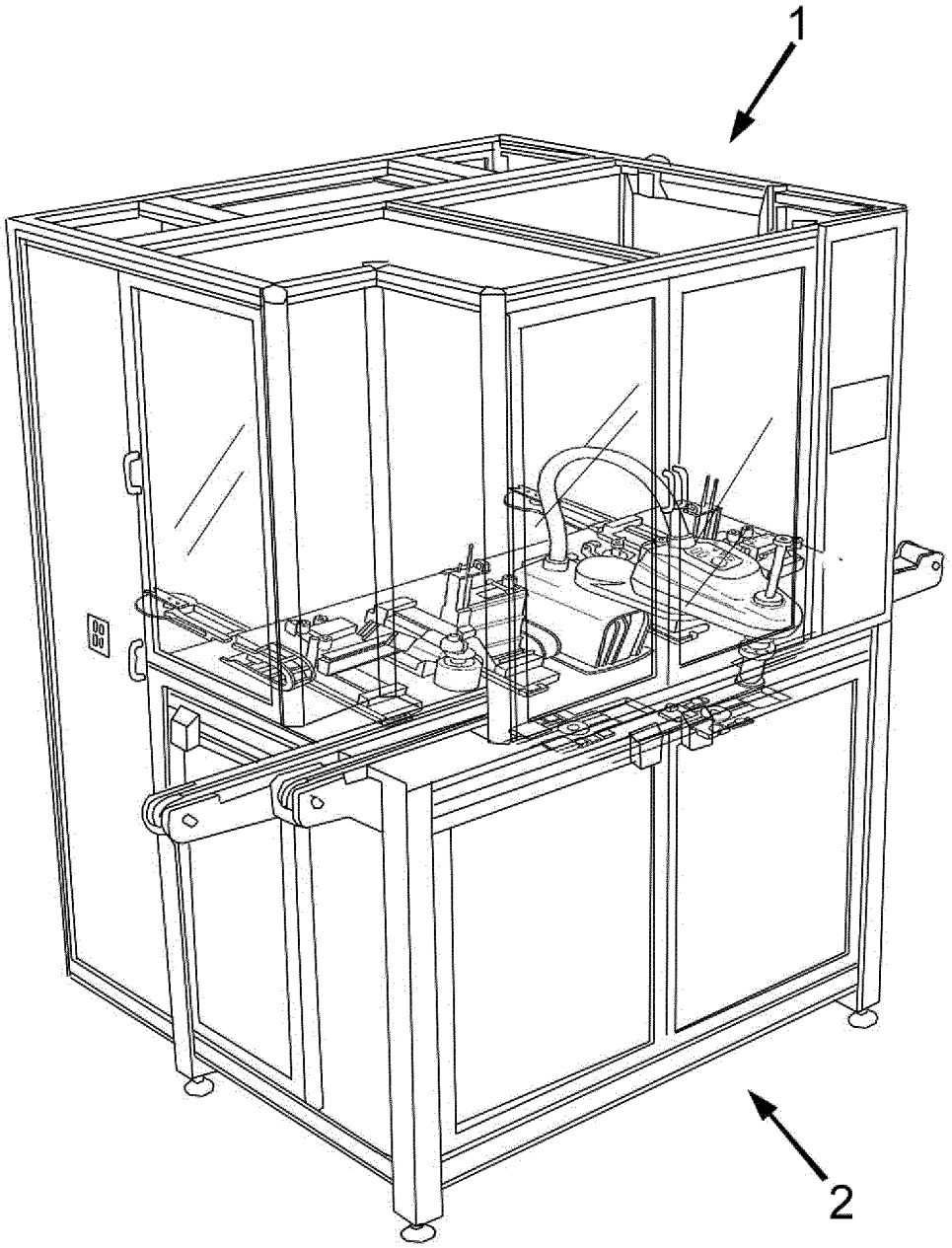

FIG. 1

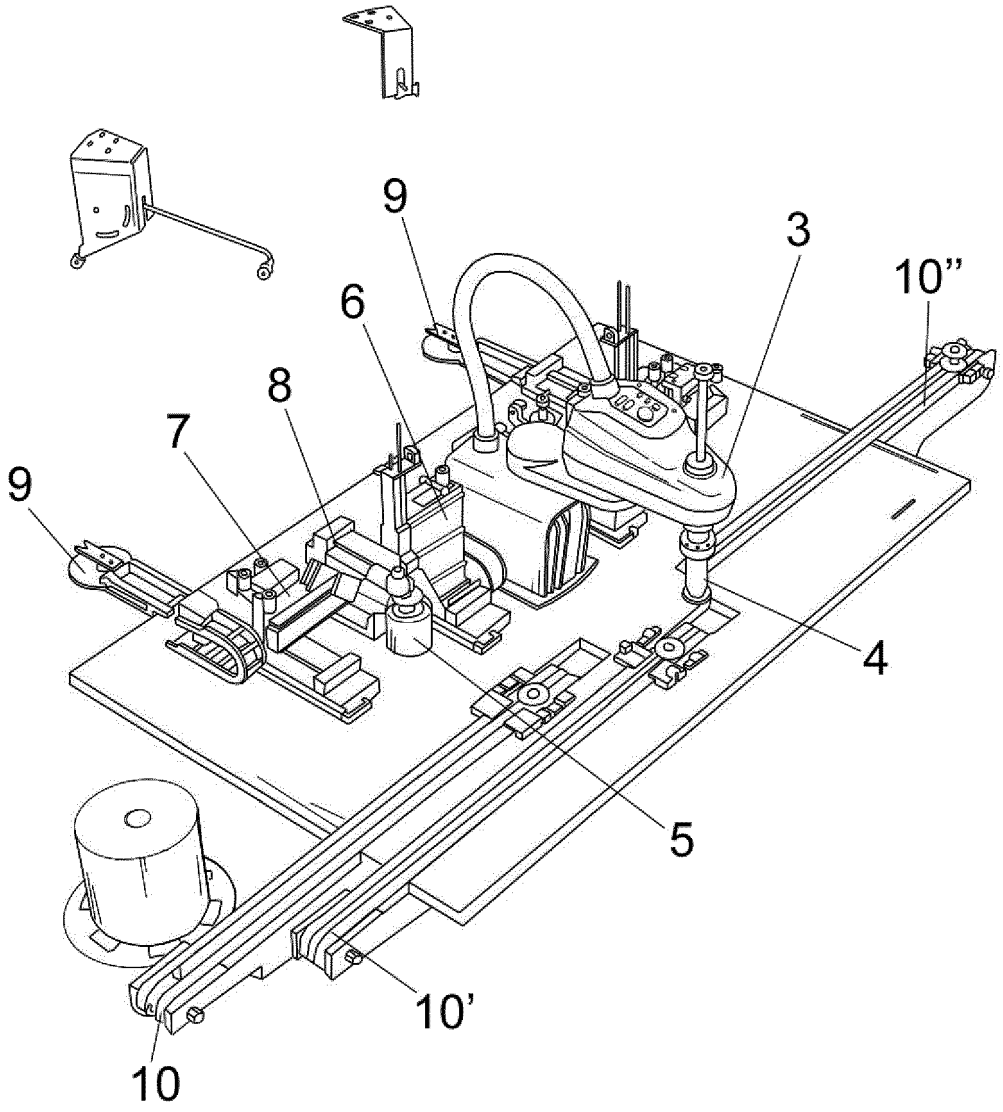

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2022/070442

A. CLASSIFICATION OF SUBJECT MATTER

B65H54/22 (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65H

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

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

EPODOC, INVENES

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 113035563 A (ESTUN HUBEI ROBOT ENG.) 25/06/2021, Figures; abstracts in databases EPODOC and WPI retrieved from EPOQUE	1 - 8
A	CN 112499371 A (ZHEJIANG GREATWAY ELECTRICAL TOOL) 16/03/2021, Figures; abstracts in databases EPODOC and WPI retrieved from EPOQUE	1 - 8
A	US 2010181413 A (DECKER) 22/07/2010, Abstract; figures	1 - 8

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

* Special categories of cited documents:
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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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Date of the actual completion of the international search	Date of mailing of the international search report
18/08/2022	**(19/08/2022)**
Name and mailing address of the ISA/ OFICINA ESPAÑOLA DE PATENTES Y MARCAS Paseo de la Castellana, 75 - 28071 Madrid (España) Facsimile No.: 91 349 53 04	Authorized officer F. Monge Zamorano Telephone No. 91 3495541

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/ES2022/070442

Patent document cited in the search report	Publication date	Patent family member(s)	Publication date
CN113035563 A	25.06.2021	NONE	
CN112499371 A	16.03.2021	NONE	
US2010181413 A1	22.07.2010	US9487374 B2	08.11.2016
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Form PCT/ISA/210 (patent family annex) (January 2015)