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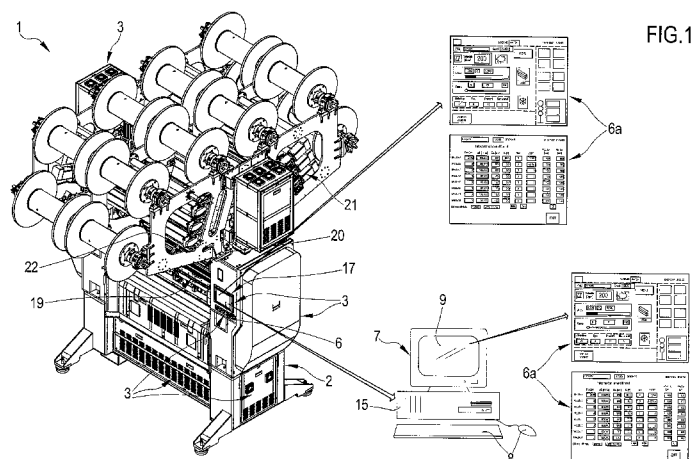
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(54) Title: A WARP KNITTING MACHINE AND A METHOD FOR ACCESS TO AND CONTROL OF THE MACHINE



(57) Abstract: A warp knitting machine, comprising: a bearing structure (2); knitting means (19); at least a thread-guide bar (20), at least a supply device (21) of yarn, activating means (22) and electric and electronic means (3) operatively connected to the activating means (22) and destined to command functioning of the warp knitting machine (1), and comprising at least a control unit (4) for at least sending command signals to, and receiving data from, the electric and electronic means (3), a device (5) for entering data to be supplied to the control unit (4) in order to enable a user to generate the command signals for the electric and electronic means (3), a display (6) for displaying at least a part of the data received by the control unit (4) in relation to the electric and electronic means (3) and comprising remote access and control means (10) for enabling a remote unit (7) to take control of a predetermined number of functions of the warp knitting machine (1).

DESCRIPTION

A WARP KNITTING MACHINE AND A METHOD
FOR ACCESS TO AND CONTROL OF THE MACHINE

5 The present invention relates to a warp knitting machine, i.e. a linear textile machine of a type commonly known as a warp machine, of the raschel or tricot type, and normally used in the production of textile manufactures of various types.

The invention also relates to a method for access and control of the knitting
10 machine.

As is known, warp knitting machines are provided with a bearing structure in which known means for production of knitwear are housed and mounted, the known means being mechanical components for carrying out the knitting function of the machine, among which, for example, are: knitting means
15 (comprising for example one or more textile needle beds, with corresponding needle bars, stitch comb bars and any tongue bars); yarn guide needle carrier bars, of the fixed or jacquard type, which are suitable for bringing the wires to form the knit at the knitting means, following a predetermined textile design; the mechanisms for actuating the moving parts of the means of the knitting means
20 and yarn guide bars; feeding devices and tensioning devices for the fabric produced by the machine. The most recent knitting machines for warp knitting are also provided with numerous electronic components, among which mention can be made at least of the number of sensors suitable for detecting various functioning parameters of the machine, the actuators suitable for enabling the
25 performing of the various operating steps, the power electronics, such as servo-drives for driving the motors, one or more processing units, etc.

In general the most recent textile machines mentioned above have in common the presence of at least a control unit which is designed to send control signals to the actuators and to receive information from the aforementioned sensors,
30 for commanding, monitoring and appropriately controlling the operation of the machine. Obviously, for the purposes of the interaction with the machine, the operator may provide commands to the control unit, as well as display data and parameters of the machine in order for proper machine functioning to be

monitored. For this purpose, at least one device is generally present for the entering of data that can be constituted by a keyboard, a mouse, suitable buttons, or even a touch screen panel; always present is also a suitable display for showing the information required and received by the sensors and/or relating to the actuators.

Over time, and with the development of computer technology, it has been also possible to store and transfer of a plurality of machine operating data which, by connecting the machine with at least one external computer thereto via an interconnection of a known type, can be transferred to the computer itself and subsequently read, reprocessed and analyzed in order to check the correct operation of one or more knitting machines. In this way it is also possible to compare, for purposes of study, statistics, or more besides, a wealth of data relating to the parameters of production of knitting machines analyzed, such as the number of stoppages, maintenance carried out, the amount of textile produced, etc.

The known machines briefly described above have some drawbacks.

First of all textile machines in accordance with the prior art always require the presence of an operator on the spot for entering programs and operating parameters, and for the control of the correct operation of the machine, as well as for the carrying out of any further operations on the machine. The known machines have therefore proved less flexible and less "user friendly", as they require the constant presence or at least frequent presence of an operator who controls and enters the data for the proper functioning of the machine and is ready to intervene by suitably modifying the operating state of the machine.

Further, known machines do not allow for effective supervision of the work done by machine operators, by the staff responsible for the supervision and control of production.

The type of machine described above enables at most a remote access to data of the machine in a totally passive way, i.e. only for a *posteriori* analysis of the data, but without enabling a true and complete interaction between a remote user and the machine itself.

An aim of the present invention is to obviate one or more of the above-cited drawbacks.

A first aim of the invention is to provide a warp knitting machine which is controllable effectively and efficiently, with a small take-up of time.

A further aim of the invention is to disclose a warp knitting machine which is user friendly, which facilitates the work of the operatives responsible for controlling it, especially in a case in which there is a plurality of machines that carry out a same production, and which enables effective supervision of the work of the machines by the operatives in charge of this task.

A further aim is to make available a warp knitting machine which guarantees high safety standards during operation.

A further aim is to make available a warp knitting machine which enables reducing the number of people required for controlling the correct functioning thereof, especially in plants in which numerous machines are present, enabling a smaller number of operatives to control even a large number of textile machines.

A further aim of the invention is to enable access to the machine only for monitoring and/or controlling intuitively, simple with the most universal modes, i.e. without requiring any special computer technology skills or knowledge of dedicated applications/devices.

A further aim is to make available a warp knitting machine which has the simplest possible structure, and which is sturdy and not overly expensive.

These and other aims that will more fully emerge during the course of the following description are substantially attained by a warp knitting machine according to the accompanying claims, in any combination among themselves and/or with one or more of the aspects indicated herein below.

In a further aspect of the invention, in combination with any one of the claims or aspects indicated herein below, the invention further relates to a warp knitting machine in which a control unit prevents the prevent the remote access and control means from taking and/or maintaining control of a predetermined number of functions of the warp knitting machine at least in the critical operating configurations for safety, which comprise at least one or more of the following operating configurations: a maintenance configuration, a regulating configuration or a manual set-up operation, a thread substitution configuration, a manual replaced configuration of parts of the machine.

In a further aspect, in combination with any one of the claims indicated in the following, the invention further relates to a warp knitting machine in which in the operating configuration in which the control unit does not prevent the control means from taking and/or maintaining control of the knitting machine, an operative working remotely can send, via a device for entering command data of a remote unit, the same command signals that can be sent using the device for manual insertion of data of the knitting machine and/or wherein it is possible to send a textile design program to the knitting machine from a remote location.

In a further aspect, in combination with any one of the claims indicated in the following or the aspects set out herein below, the invention further relates to a warp knitting machine in which the start-up of machine operation cannot be carried out from a remote location but only from the position of the machine itself.

In a further aspect, in combination with any one of the claims indicated in the claims or in the following aspects, the invention further relates to a warp knitting machine in which the access permission comprises at least a passive access to view and at least an active access to control, the control unit preventing the remote access and control means from taking control of the predetermined number of functions of the warp knitting machine in a case where the received identifying datum corresponds to an identifying datum of the predefined list associated to the passive access to view.

In a further aspect, in combination with any one of the claims indicated in the claims or in the following, the invention further relates to warp knitting machine in which the client control software is located in the remote unit, or wherein the client control software is located in a memory archive of the knitting machine, or wherein the client control software is suitable for interacting with the central control software in order to enable exchange of data between the control unit and the web server in order to reproduce, in the web pages, the user graphic interface shown on the display.

In a further aspect, in combination with any one of the claims indicated in the claims or in the following, the invention further relates to a warp knitting machine comprising at least a memory register cooperating with the control unit, the central control software being resident in the memory register in order

to be used by the control unit and/or wherein the remote unit operates in remote desktop mode, i.e. it enables remote viewing of the user graphic interface of the control unit and remotely interacting with the user graphic interface in order to control the knitting machine.

5 In a further aspect, in combination with any one of the claims indicated in the claims or in the following, the invention further relates to a warp knitting machine provided with a touch-screen control panel, comprising the control unit, the display and the data entering device and/or wherein the processing unit is provided with a real-time operating system.

10 In a further aspect, in combination with any one of the claims indicated in the claims or in the following, the invention further relates to a warp knitting machine wherein the remote unit comprises at least a memory cooperating with the processing unit, the client software control being resident in the memory of the remote unit.

15 In a further aspect, in combination with any one of the claims indicated in the claims or in the following, the invention further relates to a warp knitting machine wherein the web pages of the web server comprise the client control software.

In a further aspect, in combination with any one of the claims indicated or in the following aspects, the invention further relates to a warp knitting machine
20 wherein the client control software is not resident in or downloaded from a remote unit for access to the user graphic interface of the web pages of the web server or wherein the client software control is resident in the web pages of the web server in a language that is interpretable by a web browser or wherein the
25 client software control is resident in the web pagers of the web server in the form of scripting language or interpreted language.

In a further aspect, in combination with any one of the claims indicated in the claims or in the following, the invention further relates to a warp knitting machine wherein the plurality of further data published by the web pages of the
30 web server comprise information relating to the maintenance of the knitting machine and/or the configuration of the knitting machine and/or comprise information relating to the alarm history of the textile machine and/or the history of maintenance interventions on the knitting machine or the verifications of

functionality of the knitting machine.

In a further aspect, in combination with any one of the claims indicated in the claims or in the following aspects, the invention further relates to a warp knitting machine wherein the plurality of further data published by the web pages of the web server comprise time-related graphics of the evolution of the predetermined parameters of the knitting machine.

In a further aspect, in combination with any one of the claims indicated in the claims or in the following aspects, the invention further relates to a warp knitting machine comprising a remote unit operatively configured and connected such as to control a plurality of warp knitting machines.

In a further aspect, in combination with any one of the claims indicated in the claims or in the following aspects, the invention further relates to an access and remote control method of a warp knitting machine further comprising a step of selectively preventing the remote access and control means from taking and/or maintaining control of at least a part of the predetermined number of functions of the warp knitting machine via the remote control unit of the knitting machine.

In a further aspect, in combination with any one of the claims indicated in the claims or in the following, the invention further relates to a method comprising steps of: establishing the operating configuration of the knitting machine via the control unit, in particular using the information received from the electric and electronic means, and the step of selectively preventing the remote access and control means from taking and/or maintaining control of at least a part of the predetermined number of functions of the warp knitting machine according to the determined operating configuration of the warp knitting machine.

In a further aspect, in combination with any one of the claims indicated in the claims or in the following aspects, the invention further relates to a method comprising steps of: comparing the determined operating configuration such as to establish whether or not it belongs to a predetermined group of operating conditions that are critical for safety; and in a case in which the knitting machine is in an operating condition belonging to the group of operating conditions critical for safety, preventing the remote control access means from taking and/or maintaining control of the predetermined number of functions of the textile machine.

In a further aspect, in combination with any one of the claims indicated in the claims or in the following aspects, the invention further relates to a method comprising steps of: placing in communication, for an exchange of data, a remote unit with the warp knitting machine via the connecting means for receiving in entry at least an identifying datum coming from the remote unit; enabling and/or selectively preventing the remote control access means, via the control unit of the knitting machine, from taking control of at least a part of the predetermined number of functions of the textile machine according to the received identification datum.

In a further aspect, in combination with any one of the claims indicated in the claims or in the following aspects, the invention further relates to a method comprising steps of: comparing, via the control unit of the knitting machine, the identifying datum received with a list of predefined identifying data, access faculties to the knitting machine being assigned to each of the identifying data; establishing a correspondence between the identifying datum received and the predefined list of identifying data and associated the respective faculties of access; selectively enabling the remote control and access means to take control of a predetermined number of functions of the knitting machine according the associated access faculties.

In a further aspect, in combination with any one of the claims indicated in the claims or in the following, the invention further relates to a method wherein the access faculties comprise at least a passive access faculty, for viewing, and an active remote control access, the remote access and control means taking control of a predetermined number of functions of the knitting machine should the identifying datum received correspond to an identifying datum of the predefined list associated to the active access faculty for control.

Further characteristics and advantages will better emerge from the detailed description that follows of a preferred but not exclusive embodiment, according to the accompanying figures, in which:

- figure 1 illustrates a warp knitting machine according to the present invention, in which the knitting machine is monitored/controlled by a remote unit;
- figure 2 is a schematic view of some electronic parts of the knitting

machine of figure 1, connected to an external network.

With reference to the drawings, reference numeral 1 indicates in its entirety a textile machine for warp knitting.

The machine 1 comprises a warp knitting structure 2.

5 The machine 1 for warp knitting further comprises a plurality of components that are of conventional type, mounted on the bearing structure 2, including knitting means 19 (including various conventional elements comprising one or two textile needle beds, one or two needle bars, stitch comb bars and also possibly tab bars), at least a needle thread guide bar 20 for bringing the yarn to the
10 knitting means 19, and preferably a plurality of needle bars 20 of the fixed or jacquard type, and at least a device 21 supplying yarn to the guide needle bar 20 and to the knitting means 19, which device in the example shown is mounted above the supporting structure 2.

The machine 1 also comprises other components, not described and illustrated
15 in detail in this description since absolutely conventional and implicit in the definition of a textile machine for warp knitting, such as a pulling device of the textile fabric produced by the knitting means 19, actuating means 22, consisting of known mechanisms for moving the moving parts of the knitting means 19, the yarn guide needle bars 20 and the supply device 21, etc.

20 The knitting machine 1 also comprises a plurality of electrical and electronic means 3, which are conventional *per se* and essential for the functioning of the warp knitting machine 1, for example for the electrical connection of the various internal components of the knitting machine 1, for processing the operating programs of the knitting machine 1 and for controlling the movement of all the
25 components mentioned above.

The above-mentioned electrical and electronic means 3 of the machine 1 may in part be arranged in a second structure placed next to the bearing structure, or be entirely mounted on the bearing structure 2 of the knitting machine 1. In the preferred embodiment, the electrical and electronic means 3 for the
30 operation of the warp knitting machine 1 are integrated, housed and mounted in the bearing structure 2, and thus contained substantially within the supporting structure 2 and the closing covers.

The electrical and electronic means 3 of the knitting machine 1 include several

types of components, among which mention can be made at least of: the electronic means for the main operation of the warp knitting machine 1 for, which can include at least the power electronics, the servo-drives for driving the motors of the machine, the electronic components, sometimes called master components, that perform the processing of the machine 1 running operations and its components, such as a conventional processing unit and its components.

These main electronic means may include at least a part of the processing and control devices, that is, the CPU or processor for operating the machine, and other electronic devices such as I/O devices, i.e. analog and digital input/output devices for the connection to the remaining parts of the machine. The electrical and electronic means 3 also comprise the user interface electronic means, which are connected to the electronic means for handling the main input and output of data to a machine 1 operator. The electronic user interface means may for example include a display or monitor, a keyboard, a plurality of command buttons, and possibly a part of the processing unit or CPU, in addition to the necessary connecting cables for data, for power, etc.

In the preferred embodiment illustrated in the figures, the user interface electronic means may include a touch screen panel 17, suitable for enabling both visualization of the working parameters, and entering the parameters by an operator. The electrical and electronic means 3 also comprise secondary electronic control means of the mechanical parts of the warp knitting machine 1, which are also referred to as electronic slave means, as they are interlocked, i.e. connected to and controlled by the main electronic means. The secondary electronic means may for example include the dedicated electronics of the motors and the electronics integrated in the structure of the motors, sensors, encoders, piezoelectric devices, analog/digital converters, the data or energy connection cables, etc.

The electrical and electronic means 3 also comprise conventional electrical connection means between the various parts of the machine 1, such as, for example, connecting cables, a portion of which may also extend externally of the bearing structure 2 of the machine 1, for example for connection to the electrical supply network, and also include other conventional components that

are not mentioned for the sake of brevity.

The electrical and electronic means 3 therefore comprise at least the above-mentioned sensors for detecting operating parameters of the knitting machine 1 and also the above-mentioned actuators destined to intervene in order to
5 modify the operating parameters of the knitting machine itself. Each knitting machine 1 will comprise, in general terms, a control unit destined to send at least 4 control signals to, and to receive information from, the electrical and electronic means 3. The control unit 4 will therefore be active on all the sensors, actuators, and in general all the electrical and electronic devices mentioned
10 above, for the command and control of the operation of the knitting machine 1.

The mechanical drive and control parts are completely controlled by the set of electronic devices, which in turn are connected to an operating system integrated in the control unit 4 of the touch screen panel. The control unit 4 can for example comprise one or more digital microprocessor units or one or more
15 units of the analog and/or digital type. In practice, referring to an example of a microprocessor unit, once this unit has run an appropriate program (e.g. an external software program or one that is directly integrated in the board of the microprocessor) it is programmed, defining a plurality of modules or functional blocks which constitute means predisposed to perform respective operations.

The knitting machine is also provided with at least a display 6 for visualising at
20 least a part of the information received from the control unit 4 relating to the electrical and electronic means 3. In addition, the knitting machine will be equipped with at least one, and in general a plurality of devices 5 for data entry to be supplied to the control unit 4 to enable the user to generate the above
25 mentioned control signals for the electric and electronic means 3. The data entry devices can be of a different nature and be constituted, including in combination, by a suitable keyboard, a mouse, suitable buttons and drives or even a touch screen 17, as in the preferred embodiment illustrated in figure 1.

In particular, the display 6 or screen of the knitting machine 1 can display a
30 graphical user interface (GUI) which can give an intuitive display of at least a part of the information received from the control unit 4 and related to the sensors and actuators active in the knitting machine. Purely by way of non-limiting example, in a case in which a graphical user interface is used with a

configuration of the touch screen 17 as shown in figure 1, the display 6 itself will illustrate different regions exhibiting a plurality of touch keys and a plurality of pictograms, each for example associated with a respective touch key, as shown by the example screens shown in figure 1. Touch screen is in this case taken to mean a device that has a screen for the data output, also used for the input through the selection of parts (touch keys) of the screen directly using the fingers, and which can detect the position on which the user intervenes to send the appropriate commands for performing the corresponding action requested of the control unit 4 by the user. The adoption of a touch screen 17 may for example, configure the aforementioned display 6 and the device 5 for the input of data in a single element. The main purpose of a touch screen display is to make the interface more intuitive for the operator while simultaneously simplifying the use of the machine.

In accordance with an aspect of the invention, the knitting machine also comprises access and remote control means 10 which can enable a remote unit 7 to access the data present on the knitting machine and selectively assume control of a predetermined number of functions of the knitting machine. In general, the remote access and control means 10 comprise at least a central control software 12 suitable for enabling remote administration of the above-mentioned functions of the knitting machine; the central control software 12 can be a software-type VNC and in particular a driver VNC server. In general, the software (VNC or Virtual Network Computing) is open source software for remote control of a computer. The VNC server will cooperate with the control unit 4 which, once it has run the software, will be programmed to define the access functions and remote control. Purely by way of example the VNC server can be pre-stored on a memory register 13 of the knitting machine to which the control unit 4 can gain access.

The access and remote control means 10 can also include a client control software 14 suitable for interacting with the central control software 12 in order to enable data exchange between the control unit 4 and the remote unit 7. The control software client 14 will also optionally be of a VNC type and in particular a VNC client. In this regard note that while the VNC server will generally be memorised inside the knitting machine, the VNC client can be differently

located. The VNC client for instance, can be loaded directly onto the remote unit 7, which could be an electronic processor such as a computer, but also a handheld device or a smart-phone, or another device. Alternatively the VNC client can be directly implemented in an intermediate server which the remote unit 7 will access and which in turn will initialize communication with the knitting machine.

In a preferred embodiment the VNC client can also be loaded directly into the knitting machine 1 itself in such a way that it is possible to access for remote monitoring and control using a remote unit 7 devoid of any type of dedicated software, for example an ordinary computer, a handheld or smart phone of general type, as long as it is present on the network with the knitting machine to be monitored/controlled.

The knitting machine can also be equipped with a web server 11 operatively cooperating with the control unit 4. In general, a web server is a program dedicated to providing, on request of a browser 18, one or more web pages (often written in HTML). Moreover, the web server is usually (but not necessarily) provided with a fixed IP address on the network so as to be remotely accessible with greater ease. The information sent from web servers travel in a computer network transported by the mentioned http protocol (or by equivalent protocols).

The web server 11 of the knitting machine 1 is configured so as to provide a predetermined number of web pages that are remotely accessible via the above-mentioned connecting means 16. The web server 11 can contain the predetermined number of web pages or can generate them and send them at moment of need. In particular, the web server 11 can generate these web pages in real time and can then transmit them to a user (for example via the connecting means 16), particularly on request of the user itself. This increases the security of the system, in particular because it manages to avoid any intervention on the part of hackers on any pages resident in the memory.

Effectively, in order to reduce the risk of fraudulent intervention from the outside, the web server 11 might not necessarily operate using storage of data (web pages), but might work through a bespoke generation in real-time of data (web pages) requested.

In detail the knitting machine can be predisposed to be connected to the internet, in particular with a fixed IP address so that the web pages thereof are selectively accessible. In general a feature of a web server that publishes web pages, which is actually a website, is to be available on the net with some continuity for those who need to access them. In this sense the connection of the knitting machine can be defined as a "permanent connection" which is intended to indicate a normally active connection to the Internet network that characterises the Web sites and differentiates them from conventional clients who, on the contrary, must activate a new connection every time they need an exchange of data with any remote processor. It is clear that in cases of breakdown, maintenance, or other reasons of extremely practical nature, the connection between the machine and the internet network may be interrupted, without however altering the characteristic of substantial temporal continuity of the connection.

The connecting means 16 can include an auxiliary memory, predisposed to contain a permanent IP address univocally associated to the knitting machine, which IP address is used to define the above-mentioned permanent connection to the Internet network. In fact, a further fundamental characteristic of an Internet site lies in the fact that the server that physically incorporates the contents of the site itself is identified by an IP address (Internet Protocol), so that the server can be correctly addressed by the various routers and the providers constituting the Internet network.

The IP address, in practice, is nowadays constituted by a 32-bit number, for convenience generally represented as a sequence of four numbers, each between 0 and 255, and separated from the other through a point (for example, 192.168.9.112). As indicated above, IP addresses are used to identify the physical machines in which the web pages are contained, together with the contents annexed thereto, which constitute an Internet site. To enable network users to remember the addresses of several sites, each IP address is usually but not necessarily unique to a domain name, i.e. a kind of name or title, assigned to the site, and indicative of the contents of the site. When a network user decides to connect to a predetermined website, she or he types, in the address bar of the browser, the name or IP address of the site to be visited. In

this case, the remote user writes the domain name or IP address directly associated with the machine that he or she seeks to connect to.

The composing of this domain name is in practice the generation of the request signal; in fact, the domain name is immediately converted into the
5 corresponding IP address, so that the request is properly "routed" towards the knitting machine 1. This is made possible by the structure of the Internet network, within which the various "nodes" are able, through a series of pre-stored tables, to appropriately direct the signals towards the intended recipient. A first table enables retrieving the IP address of the recipient, using a known
10 domain name associated with it; the following tables enable covering the distance that physically separates the remote computer 7 from the knitting machine 1, by suitably choosing the branches of the network to be used for transmission. Finally, a last database associates the IP address to a branch directly connected to the recipient computer, so that information can be
15 delivered thereto.

In the light of the above, it is clear how the unique association of a permanent IP address to the knitting machine to enable it to be identified to users of the Internet network, and in particular remote users, to all effects lie a site, to which access can be gained, regardless of the physical location of the remote
20 processor 7. In some cases, for example at the moment at which the various servers and providers reorganize their internal databases, in order to optimize the exploitation of hardware-software resources and to make the most efficient operation of the network, the IP addresses associated with each site can be changed; the fact remains, however, that the IP address combined with a
25 predetermined Internet site can be defined as "permanent", as opposed to a temporary code assigned to the normal "client" each time they access the network through its provider. The same web pages provided (contained or generated in real time) in the web server 11 of the knitting machine can be viewed via a web browser 18, i.e. a program that allows users to view and
30 interact with text, images and other information contained in one or more pages of a web server.

In general, the web browser 18 is able to interpret the HTML code and display it in the form of hypertext thus allowing the web pages of the web server to be

browsed. The web server 11 present in the knitting machine 1 will be accessible through standard web browsers 18 like those today commonly used for browsing the Internet. Purely by way of example, these might be Internet Explorer, Mozilla Firefox, Opera or like web browsers for access to the web server of each of the knitting machines.

In general terms, and advantageously, the web pages of the web servers include the aforementioned client control software 14 so that the software does not have to be resident or previously downloaded to the remote control for access to the knitting machine. Clearly the control software may be a compiled software, resident on the web pages of the web server of the knitting machine from which it can be downloaded, installed on the remote and used; however it has been shown to be particularly advantageous to load the program in the web pages in the form of a specific language - such as for example a scripting language, or an interpreted programming language (i.e. that is not compiled) – destined in general for system automating tasks (batches) or applications (macros), or to be used internally of the web pages.

Examples of scripting languages are JavaScript, VBScript, Shell scripting (Unix), Perl, PHP, Python and Ruby. An example of an interpreted language is JavaApplets. All of the above means that the client program 14, in scripting language or an interpreted language, is directly and automatically executed (interpreted) by the web browser 18 without requiring any intervention by the user. The ability to directly provide the web server 11 of the VNC client 14 is a major simplification of monitoring and control procedures. It should also be noted that at least one of the web pages of the knitting machine 1 reproduces the graphical user interface displayed on the display 6 of the machine itself in addition to a plurality of further data and information relating to the knitting machine.

In detail, thanks to the above-mentioned access and remote control means 10 (which include the VNC server and VNC client) the graphical user interface displayed on the display 6 is reproduced in the pages of the web server 11 and the reproduction takes place mainly in real time. In other words, the graphical user interface reproduction is updated at each predetermined time interval and/or at every change of at least one predetermined parameter represented in

the graphical user. The above-mentioned update of the reproduction graphical user interface can also be done in the following manner, with the aim of reducing the amount of work performed by the controller. The display 6 is subdivided into a plurality of regions (distinct monitoring regions), in which each region of the display 6 is subjected to its own monitoring, and every time a change in the information is detected in a given region the updated information sent and relating only to that particular region is changed.

The user, for example through authentication with a password or similar authentication systems, can thus access the web pages of the knitting machine, receive a graphical representation which substantially coincides with the real-time graphical user interface or GUI and also navigate between the plurality of additional data published in the pages of the web server 11, such as information relating to the machine configuration (software versions loaded, cards on board, etc.). The user can on these pages also access information relating to maintenance (days since the last or before the next routine maintenance). Graphs of the variation of certain predetermined parameters can be followed, which are monitored so as to be able to follow the evolution thereof. There will be access to the history of the alarms involving the machine (e.g. the latest alarms N, the most frequent alarms etc.). Access can be gained to data relating to the history of the maintenance operations carried out on the machine, and to the control test history the machine in support of the preventive maintenance, as will be explained in the following.

As previously mentioned, however, the access and remote control means have not merely the task of enabling secure access to a plurality of data relating to the knitting machine, but also enables selective control of at least a predetermined number of functions of the machine itself. The controllable functions of the knitting machine are manifold and can in fact be the functions controlled by acting directly on the machine. Further, among the controllable functions there will be a controlled carrying-out of internal check procedures, as well as diagnostic procedures and updating or downloading software on or from the machine.

In a preferred but not exclusive embodiment, the remote access and control means enable a remote unit 7 to take full control of the knitting machine 1 so

that a remote user can interact with the machine he or she were seated in front of it. In general terms, the user must be identified on each remote connection and authentication will be carried out for example by ID authentication, with a password. In any case, remote identification can be done using various modes, possibly in combination, depending on the level of security required. Identification systems can be used that include chip cards or contactless biometric means of (fingerprint, iris or the like), or others besides.

In any case, at least an identity datum (ID) will be included among the data exchanged by the knitting machine 1 and the remote unit 7, for example from the control unit 4 (but also possibly from the web server 11 or even from the central control softwares 12). The machine 2 will keep a list of predefined identification data, and each of them will have associated respective powers of access to the knitting machine. These access rights will define actions that the user can perform on the knitting machine. Such rights include at least the right to access passive vision, i.e. the possibility of viewing web pages on the web server 11 without, however, being able to control any machine 2 functions, and at least the right to access the active control, namely the possibility of being able to actively control (i.e. change or set the operating parameters of the machine or enable/disable functions) from a remote position. In reality, the access faculties can be multiple and easily customized in such a way that each user would only be entitled to view and/or intervene on the machine 2 in a predetermined way.

Some users may have access only to view the GUI only, while others can view all machine data but cannot intervene, and still others have access only to active control only of certain machine functions and not to others; others besides will have full access to all machine functions either passively (vision) and active (control). In this way levels of access can be defined, for example for normal operators, for control and maintenance technicians or network system administrators. On each act of connection, once the identification data ID has been received, the control unit 4 (or as mentioned the web server 11 or the central control software 12) will verify the level of access authorization to give the user, with the respective access permissions and related intervention limitations. In other words, again depending on the type of secure access, the

user can remotely operate in at least one monitoring mode only (she or he will have access to all the information mentioned above, however without being able to actively interact with the knitting machine), and a full machine control mode (where the operator can interact and control the knitting machine as if seated in front of it).

Obviously there may be situations in which only a partial controlling mode is provided, i.e. only some of the functions that can be controlled by acting directly on the knitting machine. It should however be noted that the control unit 4 of the knitting machine can be arranged to selectively inhibit the access and remote control means 10 from taking and/or maintaining control of at least some of the predetermined number of functions of the knitting machine, in particular not only as a function of the user's ID, but also (or alternatively only) as a function of the operating configuration (or mode) of the machine itself. In other words, the knitting machine 1 will operate in a plurality of different operating configurations (or modes), certain of which will be more or less critical for safety.

In reference to knitting machines for warp knitting of known type, various operating configurations can as mentioned above can be evidenced, for example at least a first operating configuration of machine start-up in an occupied zone (i.e. with the presence of an operator on site) and a maintenance operating configuration, a calibrating configuration, or others besides. If the control unit 4 detects that the machine is in one of the operating configurations defined as critical for safety, the control unit 4 would be enabled to prevent the means of remote access and control 10 from taking control of the knitting machine or, in the event that the machine were under the control condition by a remote unit 7, it would be able to exclude the possibility of proceeding with the remote control/intervention. The foregoing would be true regardless of the type of subject in remote connection (operator, technician, administrator, etc). Therefore, according to the operating configuration, the control unit is automatically enabled to detect a situation of potential risk and prevent remote access by a remote user whatever the grade of authorisation of that user.

This operating mode therefore takes account of hazardous situations in which

for the purpose of sending commands to the machine it would be preferable or necessary to physically be present at the place where the knitting machine is, in order to take account of situations that cannot be perceived remotely.

In an alternative embodiment cameras may be provided for framing the knitting machine to check for the possible presence of operators, so as to enable performing further remote operations, such as for example the start-up of the knitting machine 1.

Lastly, it should be noted that in general, and to be able to fully exploit the features described above, the remote unit 7 will also be provided with a respective entering device 8 for the input of at least the command data (in this case too this may be a keyboard, a mouse or a touch screen or other suitable system) and will also be equipped with a suitable display screen 9 for displaying at least a part of the information relating to the electrical and electronic means 3 and in general the graphical user interface, substantially in real time (i.e. with substantially negligible transmission delays).

Obviously connecting means 16 will be present for placing the remote unit 7 in communication with the knitting machine 1 for exchange of data. In general terms, the connecting means 16 may be of a type in itself known and include a computer network, such as an Internet network and/or an Ethernet network and/or a wireless network, for placing the remote unit 7 (any unit 7 connected to the network) in communication with the knitting machine 1. These means 16 will be provided with the appropriate reception and transmission modules that are able to receive a request signal from the remote unit 7 and to transmit, in response to receiving, a transmission signal destined for the remote processor and incorporating data and/or one or more web pages on the web server 11 managed by the control unit 4. For this purpose appropriate communication ports, network cards and/or modems will also be present, not further described in detail as of known type *per se*.

Describing now the embodiment illustrated in the figures in greater detail, figure 1 shows a warp knitting machine 1, equipped with a touch screen panel 17 comprising at least a control unit 4 and a display 6, which also functions as data input device. In fact, an operator can interact with a graphical user interface reproduced on the display 6 by touching some parts of the display 6 configured

to define buttons for opening menus or for selecting functions or input parameters.

Figure 1 also illustrates a remote unit 7, in the example constituted by a PC equipped with a monitor 9, a keyboard 8 and a mouse, by which an operator can view the graphical interface on the display 6 of the knitting machine in real time, and interact with the GUI as if he or she were positioned at the actual knitting machine 1 and acting directly on the touch screen 17.

Figure 1 illustrates two example pages 6a of the graphical user interface (shown by way of example) reproduced identically and simultaneously both on the touch screen 17 of the knitting machine and on the remote PC screen 9. The schematic reproduction of figure 2 shows the knitting machine 1, comprising the electrical and electronic means 3 described below. The knitting machine comprises a touch screen panel 17, which in turn comprises a control unit 4, a display 6 and a device 5 for data input (in part integrated in the display, and further comprising some physical buttons, for example, the emergency stop of the machine).

The touch screen panel 17 also comprises a memory register 13, which stores the operating system of the touch screen panel, advantageously of the type Real Time, such as a system Vx Works ®. The memory register further stores a central control software 12, in particular a VNC server driver, which is part of the remote access and control means 10.

The server provides a series of data, which can be retrieved from one or more clients connected to the server. A web server 11 can be also stored in the memory register 13. In the illustrated embodiment, the touch screen panel 17 is also provided with some communication ports, including a first Ethernet connection port 31, preferably of the "Powerlink" type, one or more USB ports 32 and a second Ethernet connection port 33, and may also include other standard connection ports such as RS 232 serial ports, or more besides, not illustrated.

The touch screen panel 17 is connected via the Ethernet port 31 to a hub 23 (i.e. a multiport repeater), to which various devices 24 are connected that are part of the power driver of the knitting machine 1, operating on the machine motor axes, and some input/output devices 25 (for example suitable for

detecting the status of some analog inputs, such as the machine stops, the positioning of the axes, the state of some of the load cells, temperature sensors, etc.). A gateway 26 is also connected to the hub 23 (i.e. a network device destined to convey network packets outside of a local area network LAN) which is in turn connected to a switch 27 (e.g. a 10/100 Mbit/s type), i.e. a switch device which is connected to further electronic elements, such as some sensors 28 (yarn control units), a further external connection port and a control board 29 connected to further input/output devices, such as proximity sensors, buttons, lights, and further elements relating to the management logic of the machine.

The above-mentioned elements, connected to the first ethernet port 31, constitute a LAN internal of the machine, which generally operates via static addresses and specifically operates on the asynchronous part of the Powerlink communication. The connecting means 16 are connected to the second ethernet port 33, and connect the machine to an external network, such as a company LAN 34, which may comprise a plurality of remote units 7 of the type previously described. Each remote unit 7 can be constituted for example by a common PC, in a memory of which a client control software 14 can be stored, for example a VNC type and/or a browser 18. The remote unit 7 can be used in remote desktop mode to display the graphical interface of the touch screen panel 17 of the knitting machine 1, and perform real-time operations of reading information and activating the machine 1 as if the operator were acting directly on the panel touch screen itself.

The invention also relates to a knitting plant comprising at least a knitting machine of the type illustrated above. The knitting plant may comprise at least a knitting machine 1 and at least a remote unit 7. The knitting plant may further comprise at least a camera suitable for showing the knitting machine 1, so as to allow even remote viewing of the state of the knitting machine 1, and in particular the presence or absence of persons in the vicinity of the knitting machine, and then also enable the activating of the machine operations from the remote position, thereby avoiding situations of danger for the operators.

The invention as it is herein conceived is susceptible of numerous modifications and variations, all falling within the inventive concept. In practice the materials

used and the dimensions may be any according to requirements. Moreover all details can be replaced with other technically equivalent elements.

The invention achieves important advantages. The use of Virtual Network Computing software type or an equivalent, such as a VNC server and VNC client, allows users to be able to remotely access and monitor all the necessary information of the knitting machine 1, as well as to fully control all the functions of the knitting machine 1. Safety levels are, however, extremely high due to the fact that the control of the knitting machine is not exclusive but is filtered by the microprocessor mounted on board the knitting machine, which is able to discern the level of authorization and operation that the subject is enabled to remotely access, as well as to distinguish the operating configurations critical for safety, for which the possibility of external control is excluded. This latter operation is carried out automatically and immediately prevents hazardous situations from arising, particularly for the operator.

Moreover, the presence of a web server on the knitting machine enables remote access via the use of computers or standard handheld units without requiring the installation of additional software or the use of any special computer skills. Moreover, the presence of VNC client software (in scripting or interpretative language) directly on the web pages of the web server can be interpreted by common web browsers, even those on different platforms and operating systems (e.g. Linux, Windows and the like).

Access via security levels (defined for example by a password) exclusively enables both monitoring of the knitting machine and possibly a selective remote control thereof so that also routine maintenance operations can be performed, with the intervention of a technical operator, without any need to have to go to the place where the machine or knitting machines are operating. Complete remote control of the knitting machine 1 is possible because the machine is "full electronic", and has no need for additional manual adjustments once it has been factory set.

Finally it should be noted that the invention is simple to implement and overall costs are not high.

CLAIMS

1. A warp knitting machine, comprising
- a bearing structure (2),
 - knitting means (19) mounted on the bearing structure (2),
 - 5 - at least a thread-guide bar (20), movably mounted on the bearing structure (2), for supplying yarn to said knitting means (19);
 - at least a supply device (21) of yarn to said thread-guide bar (20)
 - activating means (22) for activating at least: some parts of said knitting means (19), said thread-guide bar (20) and the supply device (21);
 - 10 - electric and electronic means (3) operatively connected to said activating means (22) and apt to command functioning of the warp knitting machine (1), and comprising at least:
 - a plurality of sensors (28) destined to detect functioning parameters of the warp knitting machine (1);
 - 15 - a plurality of actuators (24) destined to intervene to modify the functioning parameters of the warp knitting machine (1);
 - a control unit (4) for at least sending command signals to, and to receive data from, said electric and electronic means (3), the control unit (4) sending command signals at least to said actuators (24) and/or receiving data at least from said sensors (28) such as to set and/or determine the operating configuration of the machine (2);
 - 20 - a device (5) for entering data to be supplied to said control unit (4) in order to enable a user to generate the aforesaid command signals for the electric and electronic means (3);
 - 25 - a display (6) for displaying at least a part of the data received by the control unit (4) in relation to the electric and electronic means (3);
- said warp knitting machine (1) being characterised in that it further comprises remote access and control means (10) for enabling a remote
- 30 unit (7) to take control of a predetermined number of functions of said warp knitting machine (1).
2. The warp knitting machine of claim 1, wherein said control unit (4) of the warp knitting machine is predisposed to selectively prevent the remote

access and control means (10) from taking and/or maintaining control of at least a part of said predetermined number of functions of the warp knitting machine (1) and/or wherein the warp knitting machine (1) is configurable in a plurality of different operating configurations, the control unit (4) having data relating to the operating configuration of the warp knitting machine (1) and selectively preventing the remote access and control means (10) from taking and/or maintaining control of at least a part of said predetermined number of functions of the warp knitting machine (1) according to the operating configuration of the warp knitting machine (1).

3. The warp knitting machine of any one of the preceding claims, characterised in that the machine is a full electronic type, i.e. in which the electric and electronic means (3) are apt to command substantially all the operating functions of the warp knitting machine, and/or wherein the remote access and control means (10) selectively enable said remote unit (7) to take complete control of all the functions of the warp knitting machine (1), in an analogous way to what occurs by acting directly on the device (5) to enter data and the display (6) of the warp knitting machine, in the operating configurations in which the control unit (4) does not prevent remote access and control means (10) from taking and/or maintaining control of the warp knitting machine (1).

4. The warp knitting machine of any one of the preceding claims, characterised in that the remote access and control means (10) comprise at least a central control software program (12) apt to enable remote administration of said predetermined number of functions of the warp knitting machine (1), and apt to interact with a client control software program (14) in order to enable an exchange of data between the control unit (4) and the remote unit (7) at least for reproducing, on a display (9) of the remote unit (7), a graphic user interface shown on the display (6) and/or wherein said central control software program (12) is a VNC-type program and in particular a VNC server and said client control software program (14) is a VNC-type software program, in particular a client VNC and/or wherein said client control software program (14) is configured for

enabling control of the warp knitting machine (1) in remote desktop modality.

5. The warp knitting machine of any one of the preceding claims, characterised in that the warp knitting machine (1) further comprises a web server (11) operatively cooperating with the control unit (4) and configured for publishing a predetermined number of web pages, the web pages being remotely accessible via connecting means (16) and being consultable by means of a web browser (18), wherein at least a web page reproduces a user graphic interface shown on the display (6) of the warp knitting machine (1), the web pages further publishing a plurality of further data relating to the warp knitting machine (1), the remote access and control means enabling reproduction of the web pages of the web server of a user graphic interface shown on the display (6), substantially in real time and/or wherein the web server (11) is an internet web server remotely consultable by means of a web browser (18).
6. The warp knitting machine of any one of the preceding claims, characterised in that the warp knitting machine is set up to receive in inlet at least an identifying datum (ID) originating from the remote unit (7), the control unit (4) of the warp knitting machine being configured for selectively enabling and/or preventing the remote access and control means (10) from taking control of at least a part of said predetermined number of functions of the warp knitting machine (1) in accordance with the identifying datum received and/or wherein the remote access and control means (10) are configured for receiving in inlet said at least an identifying datum (ID) originating from the remote unit (7), and/or wherein the warp knitting machine (1) comprises a list of predefined identifying data, to each of which identifying data a respective access permission being assigned to the warp knitting machine (1), the control unit (4) comparing the identifying datum (ID) received with the predetermined list of identifying data in order to establish a correspondence and, once established, selectively enabling the remote access and control means (10) to take control of a predetermined number of functions of the warp knitting machine (1) in accordance with the associated access permission

and/or wherein the access permissions comprise at least a passive access permission to view and at least an active access permission to control, the remote access and control means (10) taking control of a predetermined number of functions of the warp knitting machine (1) should the received identifying datum (ID) correspond to an identifying datum of the predefined list associated to the active access permission to control.

7. The warp knitting machine of any one of the preceding claims, characterised in that it comprises at least a remote unit (7) for distance controlling of the warp knitting machine (1), the remote control unit (7) exhibiting at least:

- a device (8) for inserting at least command data;
- a display (9) for viewing at least a part of the data relating to the electric and electronic means (3);
- a processing unit (15) for receiving the command data from the entry device (8) and for sending them, via the remote access and control means (10) and the connecting means (16), to the control unit (4) of the warp knitting machine (1), the remote unit (7) being provided with a client control software program (14) of a VNC type, or a web browser.

8. The warp knitting machine of any one of the preceding claims, characterised in that the display (6) of the warp knitting machine (1) visualizes, in use, a graphic user interface (6a) designed to intuitively show at least a part of the data received by the control unit (4) in relation to the electric and electronic means (3) and in that the remote access and control means (10) are configured such as to enable reproduction, on the display (9) of the remote unit (7), of the graphic user interface (6a) shown by the display (6) of the warp knitting machine (1) and/or such as to enable remote use of the graphic user interface (6a) for controlling the warp knitting machine (1), the reproduction of the graphic user interface on the display (6) of the warp knitting machine (1) and on the display (9) of the remote unit (7) occurring substantially contemporaneously.

9. The warp knitting machine of any one of the preceding claims, comprising

connecting means (16) apt to place in communication, for an exchange of data, a remote unit (7) with the warp knitting machine (1), the connecting means (16) comprising a computer network, for example an internet and/or ethernet and/or wireless network, for setting the remote unit (7) in communication with the machine, and/or wherein the reproduction of the graphic user interface is updated at each predetermined time interval and/or at each predetermined variation of at least a parameter represented in the graphic user interface and/or wherein the graphic user interface is sub-divided into a plurality of regions and the updating of the reproduction of the graphic user interface includes that the reproduction of each region of the graphic user be updated at each predetermined variation of at least a parameter presented in the region without updating the regions in which the predetermined variation did not occur.

10. A method for remote access and control of a warp knitting machine (1), comprising the following steps:

- predisposing at least a warp knitting machine (1) exhibiting:
 - electric and electronic means (3) apt to command functioning of said warp knitting machine (1);
 - a control unit (4) predisposed at least to send command signals and to received data from the electric and electronic means (3);
 - a device (5) for inserting data to be supplied to the control unit (4) such as to enable a user to generate the command signals for the electric and electronic means (3);
 - a display (6) for visualizing at least a part of the data received by the control unit (4) relating to the electric and electronic means (3); and
- remote access and control means (10) for enabling a remote control unit (7) to take control of a predetermined number of functions of the warp knitting machine (1);
- predisposing at least a remote unit (7), for distance control of the warp knitting machine (1), having:
 - a device (8) for entering at least the command data; and
 - a display (9) for visualizing at least a part of the data relating to the electric and electronic means (3);

- placing the remote control unit (7) in communication with the warp knitting machine (1) via connecting means (16), for an exchange of data there-between;
- remotely controlling the warp knitting machine by means of the remote unit (7), entering command data by means of the entering device (8), the connecting means (16) enabling transmission of the command data, and the remote access and control means (10) enabling the remote unit (7) to take control of a predetermined number of functions of the warp knitting machine (1).

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FIG.1

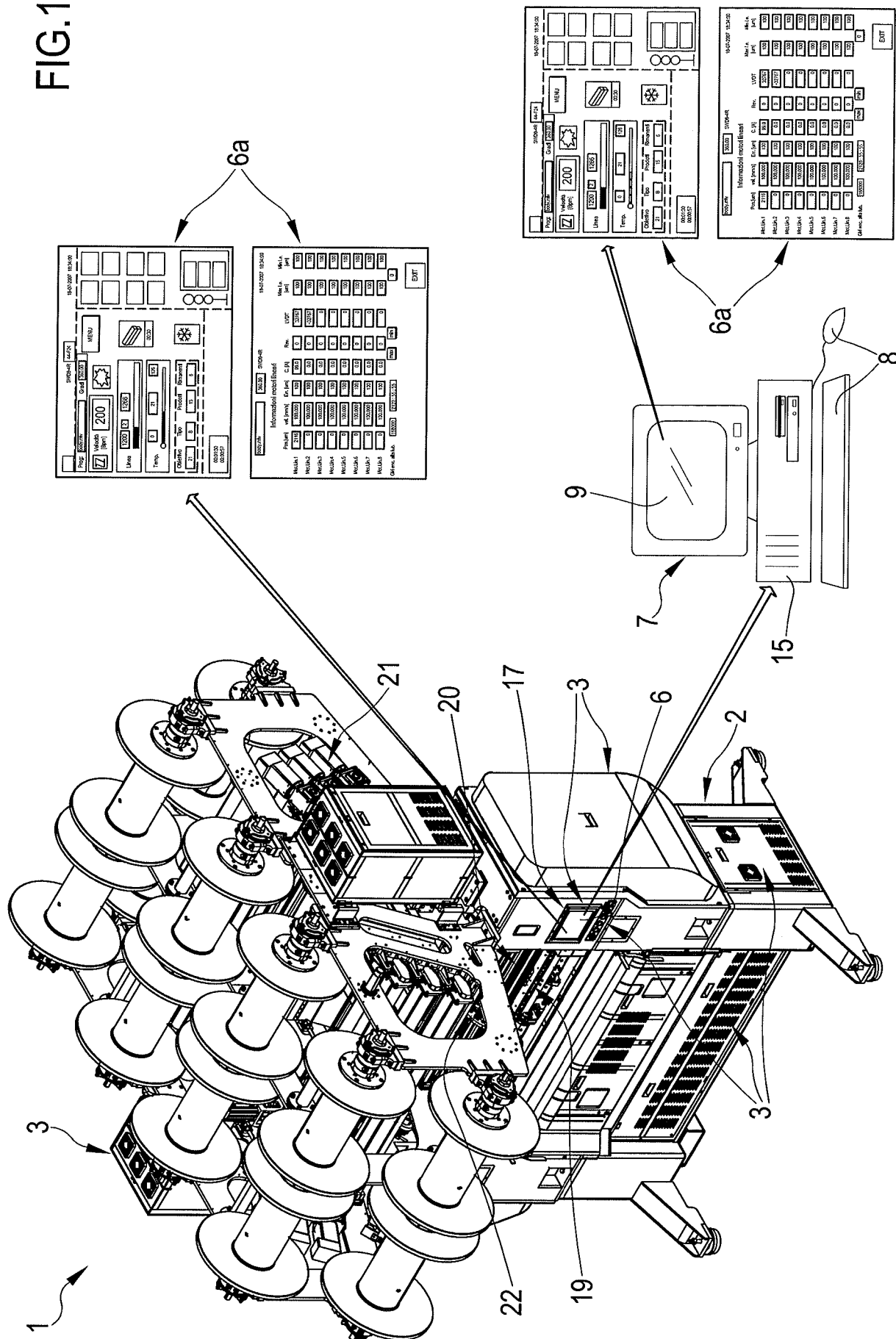
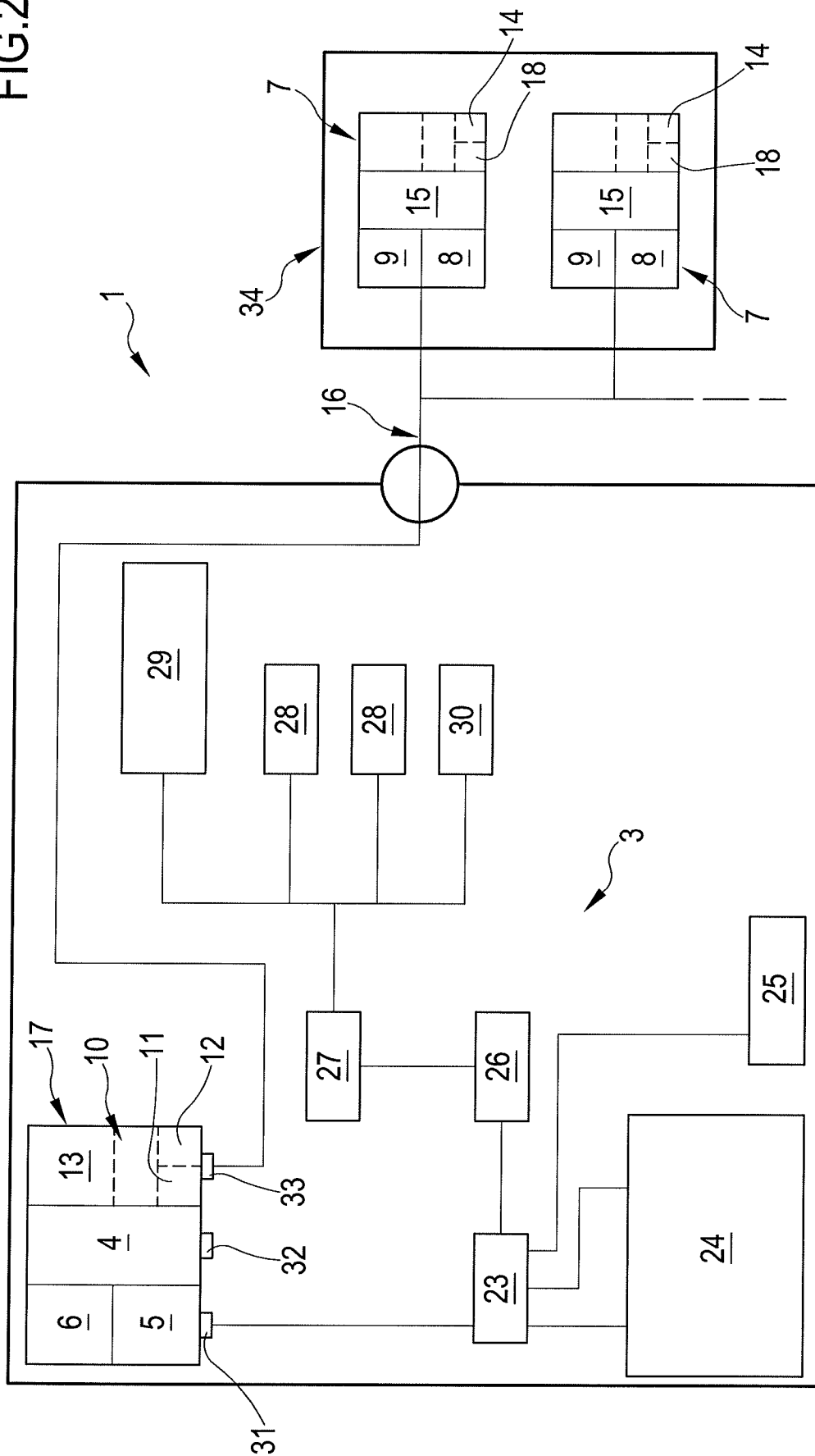


FIG.2



INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2012/051313

A. CLASSIFICATION OF SUBJECT MATTER

INV. D04B35/00 D04B35/10
ADD.

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)
D04B

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)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2000 256949 A (NIPPON MAYER LTD) 19 September 2000 (2000-09-19)	1-3, 10
Y	abstract; figures 1, 2 -----	4-9
X	DE 10 2006 025747 A1 (RIETER AG MASCHF [CH]) 6 December 2007 (2007-12-06)	1-10
Y	the whole document -----	4-9
A	DE 102 23 753 A1 (SIEMENS AG [DE]) 6 November 2003 (2003-11-06) paragraph [0018] - paragraph [0027]; figure 1 -----	1-10
A	US 2005/021168 A1 (STUWE HANS-JOACHIM [DE] STUEWE HANS-JOACHIM [DE]) 27 January 2005 (2005-01-27) abstract; figure 1 -----	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2012/051313

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