(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 009 388 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
20.04.2016 Bulletin 2016/16

(21) Application number: **15186546.6**

(22) Date of filing: **23.09.2015**

(51) Int Cl.:
B65H 54/26 *(2006.01)* ***D01H 13/00*** *(2006.01)*
D01H 13/14 *(2006.01)* ***D01H 13/16*** *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA

(30) Priority: **29.09.2014 IN 4846CHN2014**

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(54) AN INTEGRATED SYSTEM AND A METHOD FOR ENHANCING EFFICIENCY AND QUALITY IN TEXTILE YARN MANUFACTURING PROCESS

(57) An integrated sensing, control and resurrecting system for yarn breakage and other defects occurrences in a ring spinning machine is provided. Accordingly, a Control system (2) integrating an individual spindle monitoring system (1) and a transportation system (3) is provided. The transportation system can navigate and facilitate movement of work force attending to the yarn breakage and other defects upon detection by the spindle monitoring system, and the information related to yarn breakage occurrence and other defects in the spindles being sensed by the yarn monitoring system and communicated to the transporting system. The transportation system is capable of carrying both personnel and required textile material traversing along the entire longitudinal axis of the ring spinning machine for attending to the yarn breakage and other defects and ensuring quicker restoration of the yarn spinning process of the spindle of the ring spinning machine and also eliminating the production of inferior yarns due to other defects. The transportation system can be effectively used for multiple ring spinning machines for attending to yarn breakage occurrences and other defects.

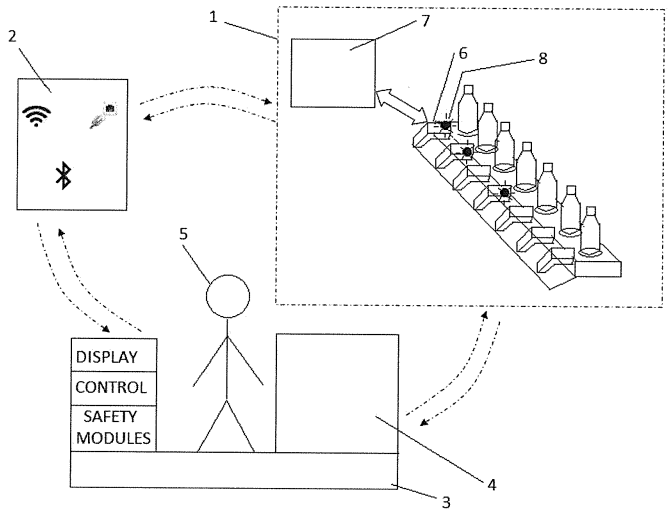

Figure 1

EP 3 009 388 A2

Description

FIELD OF INVENTION:-

[0001] The present invention relates to the handling of yarn in textile machinery. Particularly, the invention deals with the ring spinning machinery which forms part of the final line in the series of machines in yarn production and which is a very critical and key system in the textile yarn producing machinery as the end product i.e., the textile yarn, and its quality and quantity which defines itself in the yarn market is the output of the ring spinning machine. More particularly, the invention relates to the improvement in efficiency of ring spinning machinery by optimizing the man power operation required and reduction of fatigue element for the operators. Further, the invention is aimed at providing ergonomic solutions for achieving enhanced efficiency while using man power for performing the necessary operations of ring spinning machines in textile spinning process.

BACKGROUND OF INVENTION:-

[0002] It is a very well known fact that natural as well as manmade fibres are processed through various machinery and in many constituent stages in textile yarn processing. The final system of operation in the spinning process i.e., ring spinning machine forms a very critical part as the output of this system is the textile yarn, which is sought after in the textile yarn market and it is quite obvious that the textile yarn has to adhere to all desirable parameters in quality etc. Further, the yarn which is spun by subjecting the constituent textile material / filament through various process and machinery involved in textile yarn spinning would be tested randomly for checking its quality. So at any given point the yarn if it adheres to the prescribed standards would enhance the reputation of the producer and on the contrary, failure to adhere such yardsticks would result in loss of reputation in the yarn market for the yarn manufacturer.

[0003] It must be noted that at this stage apart from adhering to quality standards, the yarn produced by the spinner must be able to meet the requirements in quantity also, to be in the reckoning in the textile yarn market, whose needs are ever increasing. Thus the yarn output requirement from the ring spinning machinery has increased to manifold levels in today's scenario. As a consequence, one can see today's ring spinning machines manufactured by the textile machinery makers have increased in the lengths of the machines by tremendous factors as the number of spindles of the ring spinning machines which process the roving have increased.

[0004] Thus it can be observed that the focus on textile machinery manufacturing is more pronounced towards providing ring spinning machines which have continuous and enhanced rate of production of yarn.

[0005] It can be seen that the ring spinning system or ring frame department in any textile yarn production unit has a challenging task of continuously producing yarn adhering to the required quality parameters and in required quantities also to cater to the needs of the customers, who purchase the yarn for its usage in various applications. The ring spinning section has to employ not only a good number of ring spinning machines with considerable number of spindles which are operated in high revolutionary speeds, but also, large number of workforce / man power to obtain the yarns with required quality parameters like yarn count which is the most critical one along with yarn with less imperfections and exhibiting homogeneous properties throughout any given length of it.

[0006] Further, as one can see that with improved technology, ring spinning machines have been manufactured by producers of textile machinery with far more sophistication and attempts have been made to almost practically reduce the requirement of manpower almost to nil, replacing by automated systems like robots, for sensing of various conditions but it would result in huge escalation of cost of such machinery. Further, such machinery may not be suited for all types of requirements for achieving the spun yarn from the roving. It can be observed that involvement of manual labour in common ring spinning process cannot be eliminated considering a host of factors involved.

[0007] One can observe that '***yarn breakage***' is a highly negative phenomenon in ring frame machines, especially while they are operated in higher speeds and can seriously affect the rate of production of the yarn by the machine as well as may lead to loss of material due to wastage as well as power and time wastage etc. Yet this breakage of yarn is an unavoidable occurrence with ring frame operations as it can be observed and the manual labour employed comes to action here for attending to the spots where yarn breakage has occurred and ensuring continuous supply of yarn for getting the production of spun yarn. Also, another great negative impact caused by 'yarn breakage' occurrence in a ring spinning machine is the '***unproductive time***', caused as the spindle and the constituent components viz., rollers, rings etc are unable to produce the required yarn which is to be wound over the bobbins and derived as output of the final action of the spinning process. The aggregate of such unproductive times of various spindles in a ring spinning machine due to yarn breakage would result in big loss in the net production of yarn which is highly undesirable.

[0008] Similarly, other defects like slip spindles, rogue spindles etc. plays a major role and affects the quality of the yarn significantly. As an example, a slipping spindle which rotates at a comparatively lower revolution rate than the machine average spindle speed creates low twist in yarn which affects the strength and quality properties of the yarn. Similarly, a rogue spindle which breaks very frequently creates more piecings or joints in the yarn which causes more problems in further textile manufacturing process. The aggregate of such quality defects related to spindles affects the overall yarn quality which

is not at all desirable to the textile industries.

[0009] US Patent Document US 5170954 describes a transport system for transporting independently movable tube support members between the winding stations of a textile winding machine and a manual re-supply location is provided. The transport system includes a plurality of individual exit paths, each extending past a winding station and leading to a discharge path along which the tube support members are discharged to the manual re-supply location, and a delivery path for delivering the tube support members from the manual re-supply location to the winding stations. Also, the transport system includes a manual re-supply assisting assembly for assisting an operator with a manual re-supply operation in which full yarn packages are manually loaded onto empty tube support members. The assisting assembly preferably includes a loading guide device for guiding full yarn packages during downward travel thereof onto empty tube support members. The loading guide device includes at least two positioning members cooperating together to guide a yarn package with at least one of the positioning members being movable between a cooperating position and a displaced position in which it is laterally displaced to thereby permit relative movement of the loading guide device and the tube support members without interference between the positioning members and the yarn packages which have previously been loaded on the tube support members. Preferably, the assisting assembly includes sensors for distinguishing between empty tubes and tubes still having remaining yarn thereon and an automatic tube removal component removes tubes from the tube support members.

[0010] However, this prior art patent does not remedy the problem of identifying and rectifying yarn breakages which occurs during yarn production. Further allocation of man power in a most cost and time effective manner and carrying out the process of yarn production in a destressful manner are not found in this prior art document.

[0011] Though there are numerous attempts made till date for detection of occurrence of yarn breakage and other defects like slip and rogue spindles in ring frame machines, through spindle monitoring systems, the task of replacing of the broken yarn with a new one to resume the spinning process in ring frame machine still is done by manual methods and it remains a cumbersome and highly tedious process. One can very well observe that practically less or no attempts have been made to make the task of manual replacement of the broken yarn an easy and reliable one with less drudgery and increased efficiency. Hence the present approaches of sensing of individual spindle monitoring system for breakage of yarn or other defects can be considered as unfinished attempts and it requires integration of the spindle monitoring systems with an efficient and smart transportation system for efficient replacement of the broken yarns or attending other defects.

[0012] In view of the drawbacks and limitation discussed above, there exists a need to provide an efficient integrated system and a method for facilitating improvement in efficiency of ring spinning machinery by optimizing the man power operation required and reduction of fatigue element for the operators in identification and rectification of yarn breakages and other defects in less time. The present inventors have noted that individual spindle monitoring systems for Ring frames plays a major role in detecting and indicating the yarn breaks and other defects like slipping and rogue spindles. Further, the inventors explored the possibilities of integrating the information of individual spindle monitoring system to a transportation system which can carry the work force and material. With this integration, the transportation system navigation is automated to attend the yarn breakage and other defects quickly for achieving improved production, better yarn quality, optimized man power operation and reduced work force fatigue.

OBJECT OF THE INVENTION:-

[0013] First and foremost object of the present invention is to overcome at least some of the drawbacks of the prior art.

[0014] One possible object of the invention is to provide an integrated system for ring spinning machinery for monitoring the individual spindles in the ring spinning machine for sensing of occurrence of yarn breakage and other defects as well as providing transporting means for the personnel to attend to the yarn breakage and other defects in the least possible time for ensuring continuity in yarn production.

[0015] Another possible object of the invention is to provide a system for enhancing the efficacy of the manual labour employed in the ring spinning system of textile machinery for monitoring of yarn breakages and other defects and attending to it for continuous processing of yarn production and better yarn quality.

[0016] Another possible object of the invention is to provide a method for enhancing the efficacy of the manual labour employed in the ring spinning system of textile machinery for monitoring of yarn breakages and attending to it for continuous processing of yarn production.

[0017] Yet another possible object of the invention, to reduce the drudgery of manual labour involved in the task of attending to yarn breakage occurrences and other defects in ring frame machines by providing an integrated individual spindle monitoring as well as transporting system.

[0018] Still it is yet another possible object of the present invention, to provide a method for reducing the time delays in attending to yarn breakage and other defects in ring spinning machine and thus reducing wastage of material and minimizing loss of production of yarn and also eliminating the production of inferior yarn.

[0019] In addition, it is still a further possible object of the invention to provide an ergonomically efficient system and method for enhancing the output of the manual labour involved in the ring frame machine system of textile

yarn production with the aid of an integrated approach and mechanism for monitoring and transportation incorporated with enhanced smart technology devices.

[0020] Another possible object of the invention is to provide a system for enhancing the efficacy of the manual labour employed in the ring spinning system of textile machinery for maintaining the quality by attending spindle problems such as slip spindles, rogue spindles to eliminate the inferior yarn production and thereby increasing the overall yarn quality.

[0021] These and other advantages of the present invention will become readily apparent from the following detailed description read in conjunction with the accompanying drawings.

SUMMARY OF THE INVENTION

[0022] The following presents a simplified summary of the invention in order to provide a basic understanding of some aspects of the invention. This summary is not an extensive overview of the present invention. It is not intended to identify the key/critical elements of the invention or to delineate the scope of the invention. Its sole purpose is to present some concept of the invention in a simplified form as a prelude to a more detailed description of the invention presented later.

[0023] In an embodiment, it can be the case that an integrated system comprises at least one of the following components:

- a spindle monitoring system;
- a control system; and
- a transportation system.

[0024] **A transportation system** is a system that allows to transport goods and/or people from one location to another location. A transportation system can e.g. be a vehicle. It can be the case that the vehicle can move individually. It can be the case that the vehicle is land bound, e.g. a cart.

[0025] It can be the case that the transportation system comprises rails mounted at the top of the ring frame. It can be the case that the transportation system comprises vehicles hanging from the rails and being capable of moving along the rails.

[0026] It can be the case that a transportation system comprises one or more individually moveable vehicles and a system of pathways, e.g. a cart and a system of routes.

[0027] It can be the case that a transportation system comprises a conveyor belt.

[0028] It can be the case that a transportation system comprises a conveyor system and one or more individual units. It can be the case that the individual units are attached to the conveyor system and move according to the movement of the conveyor system.

[0029] It can be the case that a transportation system comprises a system of rails and one or more individual units that move along the rails. It can be the case that the individual units can move freely along the system of rails. If the transportation system comprises more than on individual unit, it can be the case that the individual units can be moved individually.

[0030] According to an aspect of the present invention, which can be realized independently of or in combination with other aspects of the present invention, there is provided an integrated system for sensing, detection and resurrection of yarn breakage occurrence and other defects in a textile spinning machine, said system comprising:

- at least one spindle monitoring system, capable of sensing, detection and indication of events of yarn breakage and other defects in one or more given spindles of the said spinning machine; wherein said spindle monitoring system comprising a plurality of sensing devices and one or more data collection systems adapted to collect data corresponding to each of the sensing devices;
- a control system in communication with said one or more data collection systems of the spindle monitoring system whereby the collected data are shared with said control system;
- wherein said control system further communicating with a transportation system capable of being fed with information from the control system whereby receipt of said information from the said control system triggers movement of said transportation system for transporting labour and material to a particular spindle or spindles.

[0031] A "resurrection of yarn breakage occurrence" can mean "correction of a yarn breakage occurrence" or "rectification of a yarn breakage occurrence".

[0032] For example, the transportation system can be moved to attend to yarn breakage incidents and other defects at a particular spindle or spindles for restoring and resumption of yarn production process and eliminating production of inferior yarn due to other defects.

[0033] In an embodiment, it can be the case that the system further comprises indicating means to indicate occurrence of various types of problems like yarn breakages, slipping spindles, rogue spindles creating repetitive breaks and the like, in particular wherein said indicating means facilitates colored indications corresponding to occurrence of various problems.

[0034] An "occurrence of various types of problems" here can mean an "occurrence of a specific class of problems". In an embodiment or an alternative method, it can be the case that colored indications indicate the occurrence of a specific class of problems. In particular, it can be the case that for each class of problems a different

color is used for the indication. It can be the case that the classes are defined based on one or more of the nature of the problem, the material required for solving the problem, the experience required for solving the problem, the time required for solving the problem or other aspects.

[0035] In an embodiment, it can be the case that said indicating means selectively comprise bulbs, LEDs or any other emitting means.

[0036] In an embodiment, it can be the case that data communication between said sensing devices and the data collection system being facilitated by wireless communication means and/or Bluetooth means and/or cables.

[0037] In an embodiment, it can be the case that said cable is selectively CAN, USB, RS232, RS485 or Ethernet or the like.

[0038] In an embodiment, it can be the case that said control system facilitates exchange of data/information between the said spindle monitoring system and the said transporting system by wireless communication means and/or Bluetooth means and/or cables.

[0039] In an embodiment, it can be the case that said cable is selectively CAN, USB, RS232, RS485 or Ethernet or the like.

[0040] In an embodiment, it can be the case that said transportation system comprises a navigation facility enabled through said control system in accordance to the information available on yarn breakage occurrences and other defects from the said individual spindle monitoring system.

[0041] For a transportation system comprising a navigation facility enabled through the said control system in accordance to the information available, it can be the case

- that the navigation facility is controlled by said control system in accordance to the available information; or
- that the navigation facility is fed by said control system with the available information.

[0042] In an embodiment, it can be the case that said transportation system further comprises accommodating means for work force and textile material required for replacement required for resumption of the yarn production process in the spindle of the ring spinning machine where yarn breakage and other defect incidences has occurred.

[0043] In an embodiment, it can be the case that said transportation system receives the information from said control system is capable of moving labour force with replacement textile material in such a manner that the spindle located at the nearest distance from the said transportation system where yarn breakage or other defect has occurred is attended to first and later proceeds towards the next nearest spindle with yarn breakage or other defect.

[0044] It can be the case that at any given instant resulting in optimal time of resumption of spinning process and reducing unproductive time of the spindle with yarn breakage and eliminates the production of inferior yarn due to other defects.

[0045] In an embodiment, it can be the case that the transportation system is located in a first location and the transportation system is moved to a second location, where the second location is the location of a defect and that location of a defect is closer to the first location than any other location of a current defect. "Closer" here can relate to absolute distance, or the minimal distance on a given pathway, or the time needed to move from a first spot to a second spot. It can further be the case, that - after the defect at the second location is corrected or for other reasons the transportation system shall be moved to another location - the transportation system is moved to a third location, where the third location is the location of a further defect and that location of the further defect is closer to the second location than any other location of a current defect.

[0046] In an embodiment, it can be the case that the transport system is moved according to another way optimizing algorithm or time optimizing algorithm.

[0047] Thereby, the unproductive time of the spindle, e.g. due to yarn breakage and/or eliminating the production of inferior yarn due to other defects, can be reduced. It can be the case that, at any given instant, the time required of resumption of the spinning process can be reduced, in particular that the time is optimized.

[0048] The Individual spindle monitoring system can be linked with the transportation system by means of wireless technologies or through cabling methods like Universal Series Bus (**USB**), Ethernet, Serial, Parallel communication etc.

[0049] According to another aspect of the present invention, which can be realized independently of or in combination with the other aspects of the present invention, the integrated system for controlling the yarn breakage occurrence and other defects of a ring spinning machine, comprises of a controlling system which integrates an individual spindle monitoring system which is incorporated with sensing devices for identification and communicating the occurrence of yarn breakage and other defects in a given spindle of a ring spinning machine with that of a transportation system which is modified and tailor-made for working in tandem with the spindle monitoring system wherein said sensing devices are operatively connected with plural indicating means adapted to indicate various types of problems like yarn breakages, slipping spindles, rogue spindles creating repetitive breaks and the like.

[0050] According to another aspect of the present invention, which can be realized independently of or in combination with the other aspects of the present invention, there is provided an integrated system for sensing, detection and resurrection of yarn breakage occurrence and other defects in a textile spinning machine, said sys-

tem comprising:

- at least one spindle monitoring system, capable of sensing, detection and indication of events of yarn breakage and other defects in one or more given spindles of the said spinning machine; wherein said spindle monitoring system comprising a plurality of sensing devices;

- wherein said sensing devices being provided with indicating means for glowing or illuminating when the said sensing devices detect events of yarn breakage and other defects in one or more given spindle;

- one or more image capturing means in co-operation with said sensing devices so as to capture images of illuminated indicating means,

- said image capturing means being provided or located on a transportation system wherein said image capturing means communicating information on said captured images of illuminated indicating means with said transportation system whereby receipt of said information from the said image capturing means triggers movement and/or stopping of said transportation system for transporting labour and material to a particular spindle or spindles.

[0051] For example, the transportation system can be moved to attend to yarn breakage incidents and other defects at a particular spindle or spindles for restoring and resumption of yarn production process and eliminating production of inferior yarn due to other defects.

[0052] In an embodiment, it can be the case that the indicating means comprise a radiation emitter. It can be the case that the emitted radiation is in the visible spectrum, e.g. a red or green light It can be the case that the emitted radiation is not in the visible spectrum, e.g. infrared light or a radio transmission

[0053] In an embodiment, it can be the case that said indicating means selectively comprising bulbs, LEDs or any other emitting means.

[0054] In an embodiment, it can be the case that additionally said image capturing means automatically take the information and communicate the transportation system for further navigation after a first yarn breakage and/or any other defects have been rectified.

[0055] In an embodiment, it can be the case that said indicating means facilitates colored indications corresponding to occurrence of various problems.

[0056] In an embodiment, it can be the case that the indicating means emits radiation of different wavelength for different classes of problems.

[0057] According to another aspect of the present invention, which can be realized independently of or in combination with the other aspects of the present invention, there is provided an integrated system for sensing, detection and resurrection of yarn breakage occurrence and other defects in a textile spinning machine, said system comprising:

- one or more image capturing means capable of detecting and capturing images of events of yarn breakage and other defects in one or more given spindles of the said spinning machine;

- said one or more image capturing means being provided or located on a transportation system

- wherein upon capturing images of events of yarn breakage and other defects in one or more given spindle said image capturing means communicates the received information on events of yarn breakage and other defects with said transportation system so as to trigger movement and/or stopping of said transportation system for transporting labour and material to a particular spindle or spindles.

[0058] For example, the transportation system can be moved to attend to yarn breakage incidents and other defects at a particular spindle or spindles for restoring and resumption of yarn production process and eliminating production of inferior yarn due to other defects.

[0059] In an embodiment, it can be the case that said image capturing means is adapted to scan and communicate, in particular to continuously scan and/or communicate, to the transportation system the status of delivery of yarn to the bobbin of the spindle during the movement of the transportation system.

[0060] In an embodiment, it can be the case that the transportation system and/or the individual units thereof comprise a notification means that allows

- to prevent and/or allow moving or navigation of the transportation system and/or an individual unit thereof, and/or

- to prevent and/or allow receiving or processing of information of a communication system, and/or

- to prevent and/or allow capturing or processing of images.

[0061] In an embodiment, it can be the case that the transportation system and/or the individual units thereof comprise a notification means that enables to notify a system and/or a person

- to prevent and/or allow moving or navigation of the transportation system, and/or

- to prevent and/or allow receiving or processing of information of a communication system, and/or

- to prevent and/or allow capturing or processing of images.

[0062] Such notification means can be used to indicate if the work force is currently busy, e.g. correcting a yarn breakage or another defect, and hence the transportation system should remain in place, or if the work force is available to be sent to the next location. A notification means can comprise a telephone. A notification system can comprise a button.

[0063] In an embodiment, it can be the case that the notification means can be operated by the work force on the transportation system and/or an individual unit thereof.

[0064] In an embodiment, it can be the case that the notification means can be operated by a work force not being on the transportation system and/or an individual unit thereof, e.g. a supervisor.

[0065] In an embodiment, it can be the case that the notification means can be operated by an automated or semi-automated system, e.g. an electronic surveillance system.

[0066] It should be understood that the system and the options described herein can be used in any textile processing task.

[0067] According to another aspect of the present invention, which can be realized independently of or in combination with the other aspects of the present invention, there is provided a method for resurrecting and attending to the yarn breakage and other defect incidences of the spindles of a textile yarn producing machine, the said method comprising:

- sensing, detection and indication of events of yarn breakage and other defects in one or more given spindles of the textile yarn producing machine by means of spindle monitoring system;
- wherein said spindle monitoring system comprising a plurality of sensing devices and one or more data collection systems adapted to collect data corresponding to each of the sensing devices;
- communicating and sharing said collected data with a control system;
- wherein said control system further communicates with a transportation system capable of being fed with information from the control system whereby receipt of the information from the said control system triggers movement of said transportation system for transporting personnel and material for ergonomically operating along the longitudinal axis of the yarn producing machine for attending to spindles of yarn breakage occurrence and other defects for restoring and resumption of yarn production process or eliminating the production of inferior yarns.

[0068] According to an alternative, it can be the case that indication of occurrence of various types of problems like yarn breakages, slipping spindles, rogue spindles creating repetitive breaks and the like being performed by indicating means selectively comprising bulbs, LEDs or any other emitting means.

[0069] According to an alternative, it can be the case that indication of events of yarn breakage and other defects is facilitated by colored indications.

[0070] According to an alternative, it can be the case that data communication between said sensing devices and the data collection system being facilitated by wireless communication means and/or Bluetooth means and/or cables.

[0071] According to an alternative, it can be the case that navigation of the said transportation system is enabled through the said control system in accordance to the information available on yarn breakage occurrences and other defects from the said individual spindle monitoring system

[0072] According to yet another aspect of the present invention, which can be realized independently of or in combination with the other aspects of the present invention, there is provided a method for resurrecting and attending to the yarn breakage and other defect incidences of the spindles of a textile yarn producing machine, the said method comprising:

- sensing and detection of events of yarn breakage and other defects in one or more given spindles of the textile yarn producing machine by means of spindle monitoring system; wherein said spindle monitoring system comprising a plurality of sensing devices;
- wherein said sensing devices being provided with indicating means for glowing or illuminating when the said sensing devices detect events of yarn breakage and other defects in one or more given spindle;
- capturing images of said illuminated indicating means by means of one or more image capturing means in co-operation with said sensing devices;
- said image capturing means being provided or located on a transportation system wherein said image capturing means communicating information on said captured images of illuminated indicating means with said transportation system whereby receipt of said information from the said image capturing means triggers movement and/or stopping of said transportation system for transporting labour and material to attend to yarn breakage incidents and other defects at any particular spindle or spindles for restoring and resumption of yarn production process and eliminating production of inferior yarn due to other defects.

[0073] According to an alternative, it can be the case that said indicating means selectively comprising bulbs, LEDs or any other emitting means.

[0074] According to an alternative, it can be the case that said image capturing means automatically takes the information and communicates the transportation system for further navigation after a first yarn breakage and/or any other defects have been rectified.

[0075] According to an alternative, it can be the case that colored indications, corresponding to occurrence of various problems are facilitated by the indicating means.

[0076] According to a further aspect of the present invention, which can be realized independently of or in combination with the other aspects of the present invention, there is provided a method for resurrecting and attending to the yarn breakage and other defect incidences of the spindles of a textile yarn producing machine, the said method comprising:

- detecting and capturing images of events of yarn breakage and other defects in one or more given spindles of the said spinning machine by means of one or more image capturing means;

- said one or more image capturing means being provided or located on a transportation system

- wherein upon capturing images of events of yarn breakage and other defects in one or more given spindle said image capturing means communicates the received information on events of yarn breakage and other defects with said transportation system so as to trigger movement and/or stopping of said transportation system for transporting labour and material to attend to yarn breakage incidents and other defects at any particular spindle or spindles for restoring and resumption of yarn production process and eliminating production of inferior yarn due to other defects.

[0077] In an alternative, it can be the case that the method further comprises scanning and communicating, in particular continuously determining and/or communicating, to the transportation system by the image capturing means the status of delivery of yarn to the bobbin of the spindle during the movement of transportation system.

[0078] It should be understood that the methods and the alternatives described herein can be used in any textile processing task.

[0079] Other aspects, advantages, and salient features of the invention will become apparent to those skilled in the art from the following detailed description, which, taken in conjunction with the annexed drawings, discloses exemplary embodiments of the invention.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS:-

[0080] The following drawings are illustrative of particular examples for enabling methods of the present invention, are descriptive of some of the methods, and are not intended to limit the scope of the invention. The drawings are not to scale (unless so stated) and are intended for use in conjunction with the explanations in the following detailed description. Wherever applicable, the words and phrases used herein should be understood and interpreted to have a meaning consistent with the understanding of those words and phrases by those skilled in the relevant art.

Figure 1, showing the pictorial view of the flow of the operations involved in the integrated system of control of yarn breakage and other defects in a ring spinning machine, depicting the sequential activities involved viz., the individual spindle monitoring and control system, communicating with the transportation system and the methodology involved in navigation of man power to the appropriate spot, where yarn breakage and other defects found in any given spindle of the ring spinning machine are attended to for enabling resumption of spinning process and ensuring continuous production of yarn is restored back or defect is attended in the quickest possible time.

Figure 2, depicting the block diagram showing the operation of the integrated spindle monitoring and control system in combination with that of the transportation system for navigating and moving of the labour / work force for attending to the yarn breakage and other defects observed in an given spindle while operation of the ring spinning machine.

Figure 3, showing the pictorial view of the flow of operations involved in the integrated system of control of yarn breakage in a ring spinning machine which indicates the transportation system carrying a camera which captures images of the light indication of the individual spindle monitoring system. The transportation system gets information from the camera based on the images of light indication for its movement and stoppage based on the yarn breakage or any other defects. The transportation system gets information from the camera for its movement and stoppage based on the light information from the individual spindle monitoring system enabling resumption of spinning process and ensuring continuous production of yarn is restored back or defect is attended in the quickest possible time.

Figure 4, showing the pictorial view of the flow of operations involved in the integrated system of control of yarn breakage and other defects in a ring spinning machine which indicates the transportation system carrying a camera which scans and communicates to the transportation system the status of delivery of yarn to the bobbin of the spindle continuously during the movement of transportation system for transporting labour and material to attend to yarn

breakage incidents and other defects at any particular spindle or spindles for restoring and resumption of yarn production process and eliminating production of inferior yarn due to other defects.

[0081] Persons skilled in the art will appreciate that elements in the figures are illustrated for simplicity and clarity and may have not been drawn to scale. For example, the dimensions of some of the elements in the figure may be exaggerated relative to other elements to help to improve understanding of various exemplary embodiments of the present disclosure. Throughout the drawings, it should be noted that like reference numbers are used to depict the same or similar elements, features, and structures.

DETAILED DESCRIPTION OF THE INVENTION:-

[0082] The following description with reference to the accompanying drawings is provided to assist in a comprehensive understanding of exemplary embodiments of the invention as defined by the claims and their equivalents. It includes various specific details to assist in that understanding but these are to be regarded as merely exemplary. Accordingly, those of ordinary skill in the art will recognize that various changes and modifications of the embodiments described herein can be made without departing from the scope and spirit of the invention. In addition, descriptions of well-known functions and constructions are omitted for clarity and conciseness.

[0083] The terms and words used in the following description and claims are not limited to the bibliographical meanings, but, are merely used by the inventor to enable a clear and consistent understanding of the invention. Accordingly, it should be apparent to those skilled in the art that the following description of exemplary embodiments of the present invention are provided for illustration purpose only and not for the purpose of limiting the invention as defined by the appended claims and their equivalents.

[0084] It is to be understood that the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise.

[0085] Features that are described and/or illustrated with respect to one embodiment may be used in the same way or in a similar way in one or more other embodiments and/or in combination with or instead of the features of the other embodiments.

[0086] It should be emphasized that the term "comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

[0087] Illustrative embodiments of the invention are described below. In the interest of clarity, not all features of an actual implementation are described in this specification. It will of course be appreciated that in the development of any such actual embodiment, numerous implementation-specific decisions should be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which will vary from one implementation to another. Moreover, it will be appreciated that such a development effort might be complex and time-consuming, but would nevertheless be a routine undertaking for those of ordinary skill in the art having the benefit of this disclosure.

[0088] In the present invention the integrated system for sensing and control of yarn breakage and other defect occurrences in a ring spinning machine in combination with that of a transportation system for work force for attending to the yarn breakage and other defects comprises a Control system 2 which is integrated with that of an individual spindle monitoring system 1 which is capable of sensing and monitoring the continuity of flow of yarn or any other defects in each and every spindle which is being operated in the ring spinning machine to that of a transportation system 3 which is capable of effectively moving the work force 5 along with the textile material to be used as replacement for attending to cases of yarn breakages or defects observed in any particular spindle of the ring frame machine under consideration.

[0089] The individual spindle monitoring system 1 is fitted in the ring frame 9 and is incorporated with sensors 6 placed in each spindle position. The sensors are capable of monitoring the status and operation and working condition at any given instant and information regarding operation and quality parameters of yarn obtained from these sensors are transmitted to the data collection system 7 through transmission modes like wireless or through cables. It is to be understood that such data collection system can be an interactive system, a batch system or a hybrid system which are connected to the sensors by means of physical connections through cables or wirelessly using a Bluetooth technology or wi-fi or the like. Further the sensors 6 are operatively connected with indicating means such as bulbs, LEDs and other light emitting means which would lit up to indicate occurrence of various types of problems like yarn breakages, slipping spindles, rogue spindles creating repetitive breaks and the like. It is to be understood that such indicating means can be further facilitated by bulbs or LEDs of different colours for indicating occurrence of different types of problems. It is to be further understood that bulbs or LEDs or any other light emitting means can be used alternately or in combination.

[0090] The transportation system 3 is suitably modified to work in tandem with the individual spindle monitoring system 1 and the transportation system is capable of carrying work force 5 along with the textile material along the entire longitudinal axis through the work area of the ring spinning machine 9. It is to be understood that the capability of the transportation system for carrying work force and / or desired textile materials may vary from one bay to multiple number of bays in textile yarn production

plant. Further, if the ring frame length increases, the transportation system size may vary or alternatively, two transportation system may be implemented which can start operating from two ends of the ring frame and come to an intermediate point and return after performing their function. Still further, with further increase in the length of the ring frame one can implement desired numbers of transportation systems along the length of the ring frame in which case distance and number of ring frames to be covered by each transportation system are predetermined so as to perform the operation smoothly and in a time effective and precise manner. The transportation system has provisions for display, control and safety modules for providing information and navigation. Also the system is having the requisite provision for carrying the textile material 4 to be used for attending to the yarn breakages or other defects.

[0091] Effective exchange of information between the individual spindle monitoring system 1 and the modified transportation system 3 is enabled by means of the Control system 2. The method of communication used for exchange of information is either through cable and/or air media.

[0092] The device and method for sensing and controlling of the yarn breakage occurrences and other defects of a ring spinning machine as best shown in Figure 2 comprises a transportation system 3 which is suitably modified to work with Individual spindle monitoring system 1 which is placed adjacent to the Ring frame 9 along its longitudinal axis.

[0093] The transportation system 3 which has been suitably modified to work according to the needs of the Individual spindle monitoring system 1 is operable by various possible driving means such as like mechanical, electrical, hydraulics, pneumatic and electronic means. This modified transportation system 3 works as a bobbin transportation and / or work force transportation system. The control of movement of this transportation system 3 is effected by the signals received from the Control system 2. The Control system 2 collects and logs the requisite information from the individual spindle monitoring system 1 which is fitted in Ring spinning machine 9. It is to be understood that such driving means may initially require an operator to intervene for providing the initially starting force or signal, or may not require any intervention of an operator and may be fully automated whereby reception of signals from the spindle monitoring system will start the transportation system. It may further be understood that upon receipt of signals from the Control system 2 the transportation system before starting to move towards its desired destination may set out some light and/or noise annunciators to the draw the attention of the operator(s)/work force so that they could board the transportation system if needed or simply for alerting the operator. The speed of transportation can be controlled electronically based on the number of yarn breakages or defects detected and corresponding navigation of the transportation system. Such controls are not discussed in details as it would be known to a person skilled in the art as to what controllers can be used for controlling the speed of the transportation system. The transportation system also has built in intelligence to start the navigation only on upon physical availability of the operator(s)/ work force in the transportation system.

[0094] The communication of signals from the spindle monitoring system 1 to the modified transportation system 3 can be enabled by any latest methodologies such as Wireless, Bluetooth and also by any other conventional means like cables etc. Cables can be chosen from any of the following cables like CAN, USB, RS232, RS485 and Ethernet and the like. The modified transportation system 3 contains provision for carrying textile material 4 and work force 5 for attending to breakage of yarn conditions or defects observed.

[0095] The modified transportation system 3 upon receiving signals for its navigation from the Individual spindle monitoring system 1 gets ready for its operating cycle. For example, if the modified transportation system 3 is at one end of the Ring frame 9 and if there are occurrences of two yarn breakages or two defects simultaneously in the Ring frame 9, the modified transportation system gets the signal for it to navigate to the nearest spindle break 12 or defect position from its instantaneous position and it stops for attending the yarn break 12 or defect. The work force 5 transported and travelling in this transporting system can attend the break or do any other activity required related to that spindle / spinning position. Upon completion of that activity, the modified transportation system 3 can either move automatically or the work force 5 can provide command through controls available in the modified transportation system 3 to move for the next nearest break or defect position for attending. Thus by this system the walking activity by the work force for attending to the yarn breakage or defect instances in spindles of the ring frame machine is eliminated which as a consequence reduces the fatigue and effectively improves the work efficiency of the work force 5 and also reduces the material wastage. The system also has a provision to carry the textile material 4 which may be used for replenishing the exhausted materials. The transportation system 3 is capable of moving from one end to another end of the Ring frame 9, the work force 5 upon attending to any given spindle for yarn breakage conditions or any other defects, can get down and move into another similar transportation system 3 which is available in the bay adjacently located for traversing through the other two sides of two different Ring frames 9.

[0096] The transportation system 3 is capable of automatically navigating to the position of the work force 5, for analyzing the information provided by the individual spindle monitoring system 1 about the sequence of attending of the yarn breakages 12 or defects by the work force 5. Further, a calling device 10 can be used to call by manual means, the modified transportation system 3 to the required position of the work force 5 The modified transportation system 3 can also navigate to the previous

and post textile process zones for collection and or delivery of textile materials.

[0097] The transportation system 3 is suitably incorporated with display, control and safety modules for its effective usage of the navigation in ergonomically desired way for labour involved in the operation of ring spinning machine and attending to the incidents of yarn breakage and other defects during the operation of the ring spinning machine. The fatigue involved and associated in the conventional movement of personnel attending to the yarn breakage and other defects can be seen to be considerably reduced by this integrated sensing and transportation system 3 and also the unproductive time of any particular spindle of the ring spinning machine due to yarn breakage occurrence can be considerably reduce, thus improving overall efficiency of the ring spinning machine and enhancing the yarn output and ensuring better productivity. Also by way of attending the defects like slip and rogue spindles reduces the production of inferior yarn and thereby ensures improved yarn quality.

[0098] In another embodiment (Figure 3) and not to be treated as any limitation, the transportation system 3 can carry an image capturing means such as camera 13 to scan the illuminated indications of the sensing devices of the individual spindle monitoring system 1 continuously during the movement of transportation system 3. If there is a yarn breakage or any other defects, the indicating means 8 of the sensors 6 glow or illuminate. The transportation system 3 moves continuously to see the presence of light indication 8. If there is a light 8 glowing or illuminating due to a yarn breakage or any other defects, the camera 13 senses and communicate to the transportation system 3 for stopping it immediately to facilitate the work force 5 to attend the specific spindle. Once attended, the work force 5 can give commands through the control buttons in the transportation system 3 to restart its movement for identifying the next missing yarn. Alternately, the light 8 in the sensor 6 will switch off and camera 13 will detect the change of light and command the transportation system 3 for its movement. The camera 13 will further scan the next nearest light indication from the sensor 6 of the individual spindle monitoring system 1. Alternatively, after attending, the camera 13 can automatically take the information and communicate the transportation system 3 for further navigation.

[0099] In a further embodiment (Figure 4) and not to be treated as any limitation, the transportation system 3 can carry an image capturing means such as camera 13. The image capturing means scans and communicates to the transportation system the status of delivery of yarn to the bobbin of the spindle continuously during the movement of transportation system. Upon receipt of the information on the status of delivery of yarn to the bobbin from the image capturing means, movement/stopping of the transportation system is triggered for transporting labour and material to attend to yarn breakage incidents and other defects at any particular spindle or spindles for restoring and resumption of yarn production process and eliminating production of inferior yarn due to other defects.

[0100] The advantage of embodiment referred in Fig 4 over Fig 3 is, the camera 13 scans and communicates to the transportation system the status of delivery of yarn to the bobbin of the spindle continuously during the movement of transportation system without any use of sensors.

Claims

1. An integrated system for sensing, detection and resurrection of yarn breakage occurrence and other defects in a textile spinning machine, said system comprising:

   at least one spindle monitoring system (1), capable of sensing, detection and indication of events of yarn breakage and other defects in one or more given spindles of the said spinning machine; wherein said spindle monitoring system (1) comprising a plurality of sensing devices and one or more data collection systems (7) adapted to collect data corresponding to each of the sensing devices;
   a control system (2) in communication with said one or more data collection systems (7) of the spindle monitoring system (1) whereby the collected data are shared with said control system (2);
   wherein said control system (2) further communicating with a transportation system (3) capable of being fed with information from the control system (2) whereby receipt of said information from the said control system (2) triggers movement of said transportation system (3) for transporting labour force and material to a particular spindle or spindles.

2. The system as claimed in claim 1, further comprising indicating means to indicate occurrence of various types of problems like yarn breakages, slipping spindles, rogue spindles creating repetitive breaks and the like,
   in particular wherein said indicating means facilitates colored indications corresponding to occurrence of various problems.

3. The system according to one of claims 1 to 2, wherein said transportation system (3) comprises a navigation facility enabled through the said control system (2) in accordance to the information available on yarn breakage occurrences and other defects from the said individual spindle monitoring system (1).

4. The system according to one of claims 1 to 3, wherein said transportation system (3) further comprising ac-

commodating means for work force (5) and textile material required for replacement required for resumption of the yarn production process in the spindle of the ring spinning machine where yarn breakage and other defect incidences has occurred.

5. The system according to one of claims 1 to 4, wherein said transportation system (3) receiving the information from said control system (2) is capable of moving labour force with replacement textile material in such a manner that the spindle located at the nearest distance from the said transportation system (3) where yarn breakage or other defect has occurred is attended to first and later proceeds towards the next nearest spindle with yarn breakage or other defect.

6. An integrated system for sensing, detection and resurrection of yarn breakage occurrence and other defects in a textile spinning machine, preferably according to one of claims 1 to 5, said system comprising:

at least one spindle monitoring system (1), capable of sensing, detection and indication of events of yarn breakage and other defects in one or more given spindles of the said spinning machine; wherein said spindle monitoring system (1) comprising a plurality of sensing devices; wherein said sensing devices being provided with indicating means for glowing or illuminating when the said sensing devices detect events of yarn breakage and other defects in one or more given spindle

one or more image capturing means in co-operation with said sensing devices so as to capture images of illuminated indicating means,

said image capturing means being provided or located on a transportation system (3) wherein said image capturing means communicating information on said captured images of illuminated indicating means with said transportation system (3) whereby receipt of said information from the said image capturing means triggers movement and/or stopping of said transportation system (3) for transporting labour and material to attend to yarn breakage incidents and other defects at any particular spindle or spindles for restoring and resumption of yarn production process and eliminating production of inferior yarn due to other defects.

7. The system according to claim 6, wherein additionally said image capturing means automatically take the information and communicate the transportation system (3) for further navigation after a first yarn breakage and/or any other defects have been rectified.

8. The system according to one of claims 6 to 7, wherein said indicating means facilitates colored indications corresponding to occurrence of various problems.

9. An integrated system for sensing, detection and resurrection of yarn breakage occurrence and other defects in a textile spinning machine, preferably according to one of claims 1 to 8, said system comprising:

one or more image capturing means capable of detecting and capturing images of events of yarn breakage and other defects in one or more given spindles of the said spinning machine;

said one or more image capturing means being provided or located on a transportation system (3)

wherein upon capturing images of events of yarn breakage and other defects in one or more given spindle said image capturing means communicates the received information on events of yarn breakage and other defects with said transportation system (3) so as to trigger movement and/or stopping of said transportation system (3) for transporting labour and material to a particular spindle or spindles.

10. The system as claimed in claim 9, wherein said image capturing means is adapted to scan and communicate, in particular to continuously scan and/or communicate, to the transportation system (3) the status of delivery of yarn to the bobbin of the spindle during the movement of the transportation system (3).

11. A method for attending to the yarn breakage and other defect incidences of the spindles of a textile yarn producing machine, the said method comprising:

sensing, detection and indication of events of yarn breakage and other defects in one or more given spindles of the textile yarn producing machine by means of spindle monitoring system (1);

wherein said spindle monitoring system (1) comprising a plurality of sensing devices and one or more data collection systems (7) adapted to collect data corresponding to each of the sensing devices;

communicating and sharing said collected data with a control system (2);

wherein said control system (2) further communicates with a transportation system (3) capable of being fed with information from the control system (2) whereby receipt of the information from the said control system (2) triggers movement of said transportation system (3) for trans-

porting personnel and material for ergonomically operating along the longitudinal axis of the yarn producing machine for attending to spindles of yarn breakage occurrence and other defects for restoring and resumption of yarn production process or eliminating the production of inferior yarns.

12. The method as claimed in claim 11 wherein indication of events of yarn breakage and other defects is facilitated by colored indications.

13. The method according to one of claim 11 to 12, wherein navigation of the said transportation system (3) is enabled through the said control system (2) in accordance to the information available on yarn breakage occurrences and other defects from the said individual spindle monitoring system (1).

14. A method for resurrecting and attending to the yarn breakage and other defect incidences of the spindles of a textile yarn producing machine, preferably according to one of claims 11 to 13, the said method comprising:

sensing and detection of events of yarn breakage and other defects in one or more given spindles of the textile yarn producing machine by means of spindle monitoring system (1);
wherein said spindle monitoring system (1) comprising a plurality of sensing devices; wherein said sensing devices being provided with indicating means for glowing or illuminating when the said sensing devices detect events of yarn breakage and other defects in one or more given spindle;
capturing images of said illuminated indicating means by means of one or more image capturing means in co-operation with said sensing devices
said image capturing means being provided or located on a transportation system (3) wherein said image capturing means communicating information on said captured images of illuminated indicating means with said transportation system (3) whereby receipt of said information from the said image capturing means triggers movement and/or stopping of said transportation system (3) for transporting labour and material to attend to yarn breakage incidents and other defects at any particular spindle or spindles for restoring and resumption of yarn production process and eliminating production of inferior yarn due to other defects.

15. The method as claimed in claim 14, wherein additionally said image capturing means automatically take the information and communicate the transportation system (3) for further navigation after a first yarn breakage and/or any other defects have been rectified.

16. The method according to one of claim 14 to 15, wherein colored indications, corresponding to occurrence of various problems are facilitated by the indicating means.

17. A method for resurrecting and attending to the yarn breakage and other defect incidences of the spindles of a textile yarn producing machine, preferably according to one of claims 1 to 16, the said method comprising:

detecting and capturing images of events of yarn breakage and other defects in one or more given spindles of the said spinning machine by means of one or more image capturing means;
said one or more image capturing means being provided or located on a transportation system (3)
wherein upon capturing images of events of yarn breakage and other defects in one or more given spindle said image capturing means communicates the received information on events of yarn breakage and other defects with said transportation system (3) so as to trigger movement and/or stopping of said transportation system (3) for transporting labour and material to a particular spindle or spindles.

18. The method as claimed in claim 17 further comprising scanning and communicating, in particular continuously determining and/or communicating, to the transportation system (3) by the image capturing means the status of delivery of yarn to the bobbin of the spindle during the movement of transportation system (3).

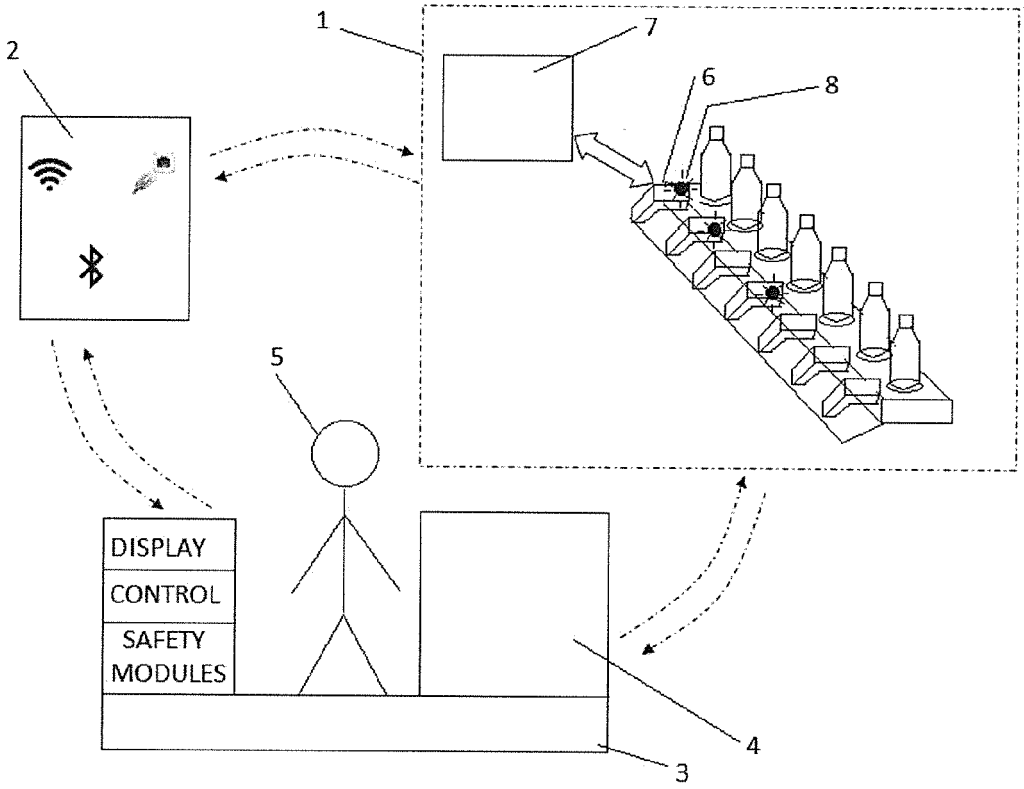

Figure 1

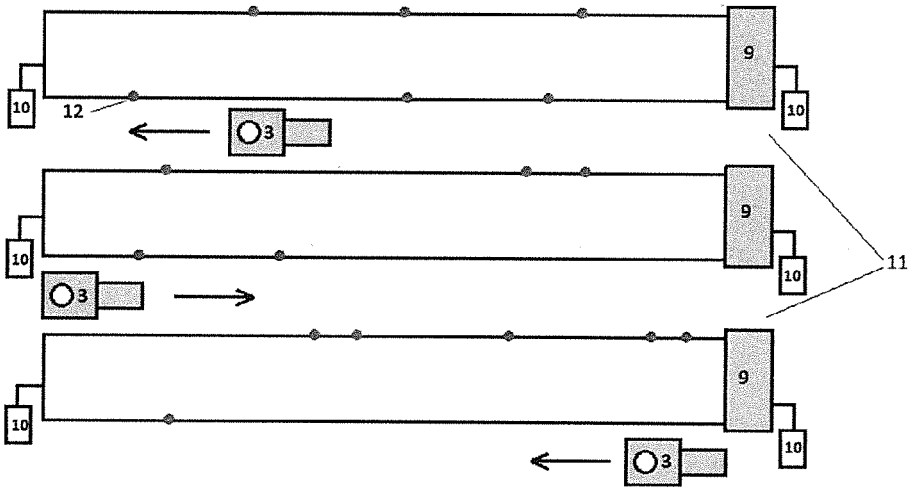

Figure 2

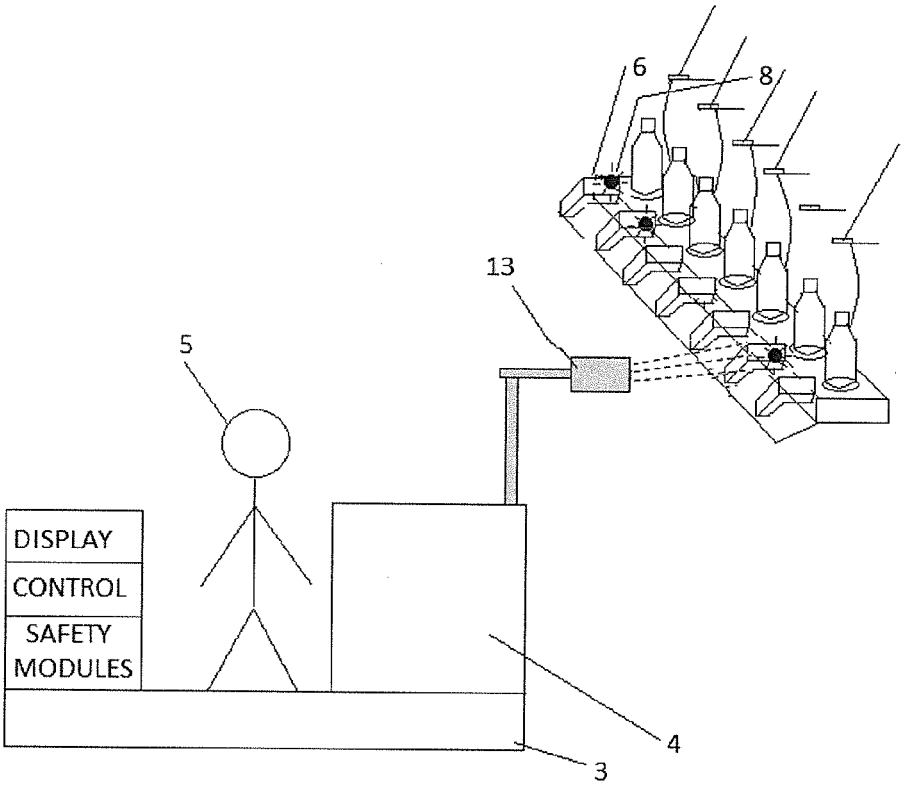

Figure 3

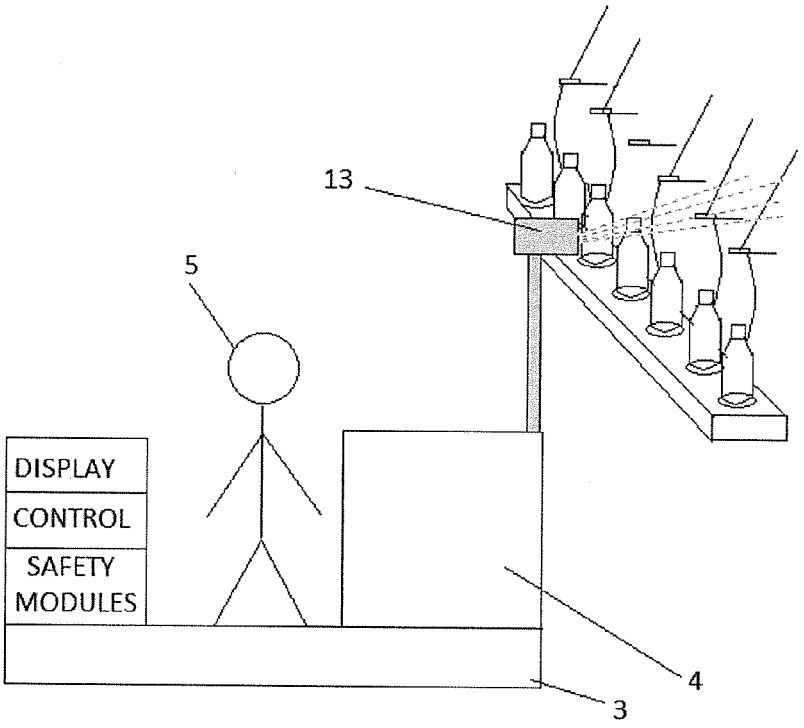

Figure 4

REFERENCES CITED IN THE DESCRIPTION

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