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(54) **PRODUCTION LINE IN THE TOBACCO INDUSTRY AND METHOD FOR INSPECTING IT**

FERTIGUNGSLINIE IN DER TABAKINDUSTRIE UND VERFAHREN ZUR INSPEKTION DAVON

LIGNE DE PRODUCTION DANS L'INDUSTRIE DU TABAC ET SON PROCÉDÉ D'INSPECTION

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Description

[0001] This invention relates to a production line in the tobacco industry and to a method for inspecting it.

[0002] The purpose of production lines in the tobacco industry is to process smoking articles.

[0003] The production lines include working units which can be removed from the rest of the line so they can be replaced during maintenance or repair work. In many cases, the working units must be adjusted, mechanically or electronically, by setting suitable parameters; adjustment may be carried out either during machine inspection prior to shipment or during maintenance or repair work after the machine has been installed.

[0004] In this context, the need arises to facilitate the work of personnel responsible for carrying out inspection and maintenance work on production lines (or machines) in the tobacco industry.

[0005] Patent documents BO2006A000110 and WO2017/182996 A1, in the name of this Applicant, describe a cigarette packing machine where some of the critical components are provided with passive transponders in which an identification code for identifying the corresponding component is stored. The identification codes of the transponders are read by corresponding antennas located along the processing line. The purpose of this system is to allow checking whether the critical components of the line are effectively original components. This technical solution therefore has some drawbacks because it does not allow any diagnosis to be performed and complicates the structure of the line (or machine).

[0006] Patent document EP2159176 discloses a device having the shape of a cigarette segment, provided with an acceleration sensor and adapted to be fed to a cigarette making machine for diagnostic purposes to measure the accelerations which the cigarette segment undergoes while it is being processed in the machine. This solution, however, also has inherent drawbacks because it does not allow inspecting the line with reference to specific components of the line; moreover, it does not allow particularly precise and accurate diagnosing of malfunctions of machine components.

[0007] This invention has for an aim to provide a production line in the tobacco industry and a method for inspecting it which overcome the above mentioned drawbacks of the prior art. This aim is achieved by the line and method according to one or more of the appended claims.

[0008] More specifically, the aim of this disclosure is to provide a production line in the tobacco industry and a method for inspecting it which can facilitate maintenance and inspection operations on specific components of the line; reference is made in particular, but non-exclusively, to the context of predictive diagnostics for component maintenance purposes.

[0009] This disclosure provides a method for inspecting the operation of at least part of a production line in the tobacco industry.

[0010] In an embodiment, inspection is performed using a probe having the shape of smoking article. In a possible embodiment, the probe includes a processor, a memory, a data exchange module and an electric power supply.

[0011] The line includes (defines) a movement path for the smoking articles (it should be noted that the movement path is a production path and hereinafter in this disclosure, the expressions "movement path" and "production path" are used equivalently). The line includes a control unit; in an embodiment, the control unit supervises the operation of the line.

[0012] The line also includes a working unit (at least one). In an embodiment, the working unit is located along the movement path. In at least one embodiment, the line may comprise a plurality of working units located in series and/or in parallel with each other relative to the movement path.

[0013] The working unit includes a tag. In at least one embodiment, the tag has a read/write memory and a data exchange interface. Preferably, the data exchange interface is configured to emit and receive data in a wireless communication. In a (preferred) embodiment, the data exchange interface is configured to emit and receive data in a short-range communication; in at least one embodiment, the data exchange interface is made according to RFID technology. In an embodiment, the tag may be an RFID tag, or RFID chip; in an embodiment, the RFID tag (or chip) is passive.

[0014] It should be noted that the term "tag" is used in this disclosure to denote an electronic component that is permanently and uniquely associated with the working unit. The tag might be a transponder.

[0015] It should be noted that the term "line" (production line in the tobacco industry) is used in this disclosure to refer to a (single) machine or to a plurality of machines which are interconnected or which interact to perform a process on tobacco products.

[0016] It should also be noted that the term "probe" is used in this disclosure to refer to an object intended to be placed in at least one position in the production (movement) path to be possibly (but not necessarily) processed by the line; the probe therefore has the shape of a smoking article (finished or semi-finished). For example, the probe may have the shape of a cigarette filter, a cigarette, a group (bundle) of cigarettes or a cigarette packet.

[0017] It should be noted that the probe advantageously allows exchanging data with the tag of the working unit through a short-range data exchange system.

[0018] A variant embodiment is also possible in which the data exchange interface is configured to emit and receive data in a medium-range communication. In addition, or alternatively, a medium-range antenna might also be used to exchange data with the tag of one or more working units of the line (or of the machine or unit of the line). In these cases, the tags of the working units could be read or written without the probe and without

removing the working units from the machine. Generally speaking, the tag (chip) of the working unit might be read (in addition or alternatively to the probe) by a specially configured electronic device which, in a possible embodiment, might be provided with a data reader element designed to be moved close to the tag or oriented in the direction of the tag (for example, according to IR data exchange technology, a Bluetooth connection or other technology).

[0019] Further, the term "working unit" is used in this disclosure to denote a line component which is detachably associated with the rest of the line so it can be removed and replaced. Preferably, the working unit is removable *en bloc.* This component may be a single element or a group of elements to form a system or device. It should also be noted that the working unit is adjustable; more specifically, the working unit is adjustable by setting at least one adjustment parameter. The working unit may be adjusted mechanically or by an electrical signal, depending on circumstances (for example, depending on the type of working unit). For example, if the working unit is a photocell, it may be adjusted remotely through a signal; if the working unit is a mechanical part adapted to interact mechanically with a smoking article (hence with the probe), for example by applying pressure thereon (for example to accommodate or hold it), adjustment may be mechanical, carried out by acting directly (mechanically) on the part itself.

[0020] It should be noted that the working unit is preferably adjustable individually, in the sense that setting the adjustment parameter is effective directly on the operation of the working unit but does not have a direct effect on other parts of the line. It should be noted the working unit is adjustable independently, in the sense that it can be adjusted by operating only on its own parameter (or parameters) without operating on the adjustment parameters of other working units or parts of the machine; preferably, the working unit does not include components which can in turn be adjusted independently (that is to say, a working unit does not contain any subcomponent which itself constitutes a working unit).

[0021] As to the production line in the tobacco industry, it may comprise one or more of the following machines or units: a unit for making cigarette filters; a unit for making cigarettes (connected to the filter making unit to receive filters therefrom); a storage unit to store the cigarettes received from the cigarette making unit; a cigarette packing unit (connected to the storage unit or to the cigarette making unit to receive the cigarettes); a cellowrapping unit (connected to the cigarette packing unit to wrap the cigarette packets in a transparent plastic film or cellophane); a cartoning unit (connected to the cellowrapping unit to form cartons of cigarette packets).

[0022] The shape of the probe depends on the part of the line to be inspected, that is to say, on the unit or part of the unit in which the probe must be loaded.

[0023] For example, to inspect the cigarette making unit, the probe may be shaped like a cigarette filter; to inspect the storage unit, the probe may be shaped like a cigarette; to inspect the cigarette packing unit, the probe may be shaped like a cigarette or a group of cigarettes; to inspect the cellowrapping unit, the probe may be shaped like a cigarette packet; to inspect the cartoning unit, the probe may be shaped like a (cellowrapped) cigarette packet or like an ordered group of packets.

[0024] As regards the cigarette packing machine in particular, it should be noted that this machine receives loose cigarettes through its infeed end and, through a succession of processing stations, delivers complete cigarette packets through its outfeed end. At least one station of the cigarette packing machine receives individual cigarettes, while at least one of the other stations of the machine receives groups (bundles) of cigarettes. In this machine therefore, a probe shaped like a cigarette can be loaded at the entrance to the first station or a probe shaped like a group (bundle) of cigarettes at the entrance to at least one other station.

[0025] The method according to this disclosure comprises a step of loading the probe into the line at a loading position located along the movement (production) path.

[0026] The method also comprises a step of transferring data between the probe and the tag of the working unit when the probe is located at an operating position along the movement path. It should be noted that the operating position may coincide with the loading position or it may be, relative to the loading position, an advanced position along the movement (production) path.

[0027] Thus, thanks to the method according to this disclosure, data can easily be written to a working unit and follows that working unit even when the working unit is removed from the machine where it was originally fitted and is, for example, installed in another machine, or substituted or repaired; the method also allows that information to be just as easily read. That facilitates maintenance and checking of the working units, which are specific components of the line.

[0028] The data items which can be stored in the tag of the working unit (and which constitute its "identity card" so to speak) are listed below by way of non-limiting example:

- working unit identification code;
- date of working unit manufacture;
- date of one or more adjustments carried out on the working unit;
- values of one or more adjustment parameters set during one or more adjustments carried out on the working unit;
- date of activation of the probe;
- operating time interval of the working unit;
- type of one or more machines which the working unit has worked in;
- position of the working unit inside one or more machines which the working unit has worked in;
- diagnostic data referred to the working unit derived during a step of diagnosing the line;

- one or more of the data items contained in the control unit of the line.

[0029] A time stamp, indicating the time one or more of the data items listed above, or other data items are stored, can also be stored in the tag (chip) of the working unit.

[0030] In an embodiment, other data items (for example, one or more of the items listed above) may be stored in the tag (chip).

[0031] According to one aspect of this disclosure, data representing specifications provided by the manufacturer of the machine (or working unit) - for example, data relating to operating limits or tolerances, calibration or testing - can be stored in the tag (chip).

[0032] In this context, it should be noted that the inspection method according to this disclosure can advantageously be used in different application circumstances.

[0033] A first application circumstance of the inspection method is checking the design of a machine or production line (by the manufacturer of the machine or line) to verify compliance with specifications regarding the smoking article (for example, the packet) or the interaction between the smoking article and the machine.

[0034] A second application circumstance of the inspection method is checking the operation of the machine (by the manufacturer of the machine or line), for example before the machine is shipped to the factory where it is to be installed and/or after installation.

[0035] A third application circumstance of the inspection method is checking the operation of the line after some time has passed (with a view in particular to verifying compliance with specifications regarding the smoking article or the interaction between the smoking article and the machine); this check is intended to be carried out after the line or machine has worked for a certain length of time (predetermine, for example) and may be conducted by the user of the line.

[0036] In this context, the possibility to easily store on the working units themselves information regarding their manufacture (for example, date and place), manufacturer's specifications and, subsequently, inspection and maintenance (for example, details and dates of adjustments) and to easily retrieve that information after some time has passed (at any time, even without necessarily stopping the machine) allows diagnosing machine operation taking into account the "historical" data stored in the individual working units and considering that the working units may, over time, have been replaced (in the trade, this practice is known as "reconditioning") with new working units or "used" working units taken from other machines.

[0037] In an embodiment, the control unit may be provided with a machine operation counter; and when the packet probe is loaded into the machine, the probe incrementally writes the operating hours to the tags of the working units. This allows storing information regarding the actual operating time of the working units in the tags of the operating units themselves.

[0038] The tag also stores the date of production of the working unit (which constitutes a "date of birth" of that working unit); this information item is useful to carry out (programmed) maintenance based on absolute time, irrespective of the actual time worked.

[0039] The type and location of the machines a working unit has operated in might also be written to (stored in) the tag. The position of the working unit in a machine might also be written to (stored in) the tag. Some of the data stored in the control unit might also be written to (stored in) the tag when the probe passes.

[0040] According to an aspect of this disclosure therefore, the probe fulfils a function that may be likened to that of a logbook manager. In effect, the probe can read from and write to the tags of the working units; in light of this, the tag of the working unit fulfils a function that may be likened to that of a rewritable logbook integrated in the working unit. In an embodiment, the method comprises a step of feeding the probe along the movement path, where the loading position is located upstream of the operating position, along the movement path.

[0041] When it passes along the movement (conditioning) path in the machine (if necessary, at a lower speed than the nominal speed), the probe may therefore pass by in the proximity of the tags of the working units (for example, a few centimetres away) to exchange data therewith.

[0042] In at least one embodiment, the probe is sensorized.

[0043] According to another aspect of this disclosure, the (sensorized) probe is designed to facilitate the work of the installer or tester when setting (or adjusting) the working unit (or units). In this case, the machine is (preferably) stationary while this is being done.

[0044] The probe is positioned along the movement (production) path in an operating position at the working unit to be conditioned so that the data exchange module of the working unit to be conditioned is in communication with the tag of the working unit in order to write data to the tag.

[0045] The operator adjusts one or more adjustment parameters of the working unit by varying the value of the adjustment parameter (by acting on a mechanical or electrical adjustment element) until it adopts a desired value (for example, a value that falls within a preset range, provided by the manufacturer).

[0046] When adjustment is complete, the set value of the adjustment parameter is stored in the tag of the working unit, preferably together with a time stamp indicating the date on which the adjustment was carried out; other information may also be stored: for example, information indicating ambient temperature, humidity or other variables in the machine at the time the adjustment was carried out (in this case, the probe is provided with corresponding temperature, humidity or other sensors).

[0047] In an embodiment, it is the probe itself that measures and transmits a signal representing the value

of the adjustment parameter measured in real time by the probe; that way, the probe provides the operator with feedback regarding the adjusting action taken by the operator.

[0048] For example, if the working unit is a head adapted to hold a group of cigarettes and the parameter being adjusted is the pressure applied by the head on the group of cigarettes, the probe used is the one shaped like a group (bundle) of cigarettes and provided with a sensor for measuring the pressure applied on the probe. In this case, the operator places the probe in the head (or loads it in the machine upstream of the head and moves it until it is positioned in the head) and then operates (mechanically) on the head to vary the pressure it applies on the probe (corresponding to the pressure that the head would, in use, apply on a group of cigarettes). During this operation, the probe measures the adjustment parameter in real time and transmits it to a screen for the operator to see (for example, a graphical interface connected to the control unit, or a tablet or other electronic device in communication with the probe). The operator sets the adjustment parameter to the desired value as a function of the value displayed and the variations thereof. Lastly, the operator indicates that adjustment is complete, causing the value to be set in the working unit and stored in the tag of the working unit, as described above.

[0049] Similarly, the probe may be used in a step of checking the working unit in which the probe performs a step of reading the memory of the working unit tag to retrieve the data contained therein (for example, historical values of one or more adjustment parameters set during a previous step of adjusting carried out on the working unit).

[0050] In an embodiment, the step of checking the working unit also includes a step in which the probe (which, in this case, must be sensorized) performs a step of detecting the current values of the one or more working unit adjustment parameters. This allows comparing the historical values with the current values of the adjustment parameter of the working unit (for example, for diagnostic purposes, for example to carry out predictive maintenance).

[0051] According to another aspect of this disclosure, if the probe is provided with suitable sensors, it may be used in the machine as if it were a smoking article being processed (preferably with the machine running at its nominal speed) to acquire information on the mechanical or thermal stresses which the smoking article undergoes while it is being processed or to acquire information regarding the state or operation of one or more of the machine components which the smoking article interacts with during its processing along the movement (production) path.

[0052] According to one aspect of this disclosure, therefore, the probe can fulfil at least two different functions: (i) inspecting the line or a part thereof by reading or writing data from or to the tag of one or more working units of the line; (ii) diagnostically analysing the operation of the line or part thereof by processing the probe in the machine and acquiring data which is time-correlated with the operation of the line.

[0053] These functions may be fulfilled by the same probe or by two probes of two different kinds having technical features specific for the different functions: for example, an inspection probe for function (i) and a diagnostic probe for function (ii).

[0054] It should be noted that in its inspecting function, the probe constitutes a link, or communication interface, between the control unit and the tag of the working units.

[0055] The data captured by the probe may be processed by the probe itself or by the control unit or other electronic devices (for example, a tablet for configuring the line or machine).

[0056] This disclosure thus also provides a production line in the tobacco industry.

[0057] The line comprises a machine (or a plurality of machines) for continuously processing a succession of smoking articles; the machine is a processing unit or station.

[0058] The line (or machine) defines a movement (production) path for the smoking articles.

[0059] The machine (the line) includes a working unit or a plurality or working units. In an embodiment, the working unit is located along the movement path of the smoking articles.

[0060] The working unit includes a tag. The tag has a read/write memory and a data exchange interface.

[0061] The machine (the line) includes a control unit which supervises the operation of the machine (of the line).

[0062] In an embodiment, the machine (the line) includes a probe which is shaped like a smoking article.

[0063] The probe comprises a processor, a memory, a data exchange module and an electric power supply.

[0064] The data exchange interface of the tag and the data exchange module of the probe are configured to transfer data between the probe and the working unit tag, at an operating position of the probe. Preferably, the operating position is located along the movement path.

[0065] It should be noted that the line may include one or more of the following machines or units for the processing of smoking articles: a unit for making cigarette filters ("filter maker"); a unit for storing and/or feeding filters; a unit for making cigarettes ("cigarette maker" combined with "filter tip attachment"); a unit for storing and/or feeding cigarettes; a unit for packing cigarettes ("packer"); a unit for storing packets; a unit for overwrapping packets ("cellowrapper"); a unit for making cartons ("cartoner"); a case packing unit ("case packer") and palletizer.

[0066] With regard to the machine (or unit) for packing cigarettes, attention is drawn to the following.

[0067] The cigarette packing machine ("packer") receives as input a (continuous) unordered flow of cigarettes from the cigarette making machine and, by means of a hopper, forms ordered groups of cigarettes, known as "bundles".

[0068] A possible position for loading the probe in the cigarette packing machine is downstream of the hopper: in this case, the probe is shaped like an ordered group, or bundle, of cigarettes.

[0069] The packing machine includes at least one carousel (wrapping wheel); in an embodiment, the working unit includes a plurality of carousels disposed in succession along the movement path. For each carousel, the packing machine has a plurality of heads; the heads are connected to the carousel to rotate as one therewith. In a first carousel, each head receives an (ordered) group of cigarettes and acts in conjunction with suitable tools to wrap foil paper and a collar around the (ordered) group of cigarettes. A second carousel receives the objects (the bundles of cigarettes wrapped in foil and provided with a collar) individually from the first carousel. In the second carousel, each head acts in conjunction with suitable tools to wrap a blank round the outside of a respective object.

[0070] In at least one embodiment, each head (of each carousel) may define (constitute) a working unit (according to one or more of the features included in this disclosure).

[0071] According to one aspect of it, this disclosure provides a production line (machine) in the tobacco industry, including at least one working unit equipped with a tag, where the tag has a read/write memory, to exchange information with an interrogation device ("reader") according to one or more of the features included in this disclosure. In this aspect of it, the disclosure must not be understood as being limited by the embodiment of the interrogation device; in this sense, the fact that the interrogation device is a probe shaped like a smoking article and adapted to be processed by the machine is one of the possible embodiments.

[0072] According to one aspect of it, this disclosure provides a production line (machine) in the tobacco industry, including a working unit (at least one) equipped with a tag, where the tag is positioned along a movement (production) path of the smoking articles and is readable/writable by (an interrogation device consisting of) a probe which is shaped like a smoking article and adapted to be processed by the machine, according to one or more of the features included in this disclosure. In this aspect of it, the disclosure must not be understood as being limited by the embodiment of the tag; in this sense, the fact that the tag has a read/write memory to exchange information with an interrogation device (the probe) is one of the possible embodiments.

[0073] This disclosure thus also provides a working unit of a production line (machine) in the tobacco industry.

[0074] The working unit comprises a body which is geometrically configured to removably connect the working unit to the line (machine).

[0075] In an embodiment, the working unit comprises an adjustment mechanism. The adjustment mechanism is configured to set at least one mechanical and/or electrical adjustment parameter. The adjustment parameter may be detectable from outside the working unit.

[0076] The working unit also includes a tag having a read/write memory and a data exchange interface, according to one or more of the features included in this disclosure.

[0077] These and other features will become more apparent from the following detailed description of a preferred embodiment, illustrated by way of non-limiting example in the accompanying drawings, in which:

- Figure 1 schematically illustrates a production line in the tobacco industry according to this disclosure;
- Figure 2 illustrates a cigarette packing machine of the line of Figure 1;
- Figure 3 illustrates a detail of the machine of Figure 2;
- Figure 4 schematically illustrates a production line in the tobacco industry according to this disclosure, in connection with one of the possible uses of the probe;
- Figure 5 illustrates a probe according to this disclosure;
- Figure 6 illustrates a variant embodiment of the probe of Figure 5.
- Figure 7 illustrates a further variant embodiment of the probe of Figure 5.

[0078] The reference numeral 1 denotes a line for the production of articles of the tobacco sector (in particular, for making cigarettes), hereinafter also referred to as products of the tobacco industry or smoking articles.

[0079] The line 1 may comprise one or more machines or units which are connected, specifically in succession, along a movement path (Figure 1). Described briefly below are some of the machines or units which the line 1 may include.

[0080] The line 1 may comprise a machine 201 known as "cigarette maker" configured to make a cigarette rod segment containing tobacco (without filter). The cigarette maker 201 allows wrapping a predetermined quantity of tobacco in a sheet of paper to make a plurality of rods of tobacco wrapped in paper of predetermined size and length which will subsequently constitute cigarettes. An example of the cigarette maker 201 is well described in patent document EP2522237B1 which is in the name of the same Applicant as this invention and whose content (with particular regard to structure, functions and operating modes of the component parts of the machine) is incorporated herein by reference.

[0081] The line 1 may comprise a machine 3 known as "filter maker", constituting a unit for making filters.

[0082] The line 1 may also comprise a filter tip attachment machine 202, configured to couple the filter made by the filter maker 3 to the cigarette rod segment made by the cigarette maker 201. The filter tip attachment machine 202 allows attaching one or more segments of filter material, that is, a "combined" filter or filters, to an element of predetermined size and length previously made by the cigarette maker 201 in order to make a finished cigarette.

An example of the filter tip attachment machine 202 is well described in patent document EP1791146B1 which is in the name of the same Applicant as this invention and whose content (with particular regard to structure, functions and operating modes of the component parts of the machine) is incorporated herein by reference.

[0083] The cigarette maker 201 and the filter tip attachment machine 202 form a unit 2 for making cigarettes.

[0084] The line 1 may also comprise a packing machine 4, which constitutes cigarette packing unit. The packing machine 4 is configured to make a packet of cigarettes containing a predetermined number of cigarettes.

[0085] An example of the packing machine 4 is well described in patent document EP1267231A1 which is in the name of the same Applicant as this invention and whose content (with particular regard to structure, functions and operating modes of the component parts of the machine) is incorporated herein by reference.

[0086] The line may also comprise a storage unit 7. In an embodiment, the storage unit 7 is interposed between the unit 2 for making cigarettes and the packing machine 4; in such a case, the function of the storage unit 7 is to store the cigarettes received from the unit 2 for making cigarettes and to feed them to the packing machine 4, thereby making available a storage "buffer" of cigarettes.

[0087] The line 1 may also comprise a cellowrapping machine (or unit) 5, or unit for overwrapping the packets. The cellowrapping machine 5 is configured to apply a packaging film round the outside of the packets of cigarettes; the cellowrapping machine 5 is connected to the packing machine 4 downstream of the latter. More specifically, the cellowrapping machine 5 allows the packets of cigarettes to be wrapped in transparent or printed, heat-sealable plastic material. An example of the cellowrapping machine 5 is well described in patent document EP1640268B1 which is in the name of the same Applicant as this invention and whose content (with particular regard to structure, functions and operating modes of the component parts of the machine) is incorporated herein by reference.

[0088] The line 1 may also comprise a cartoning machine 6, or cartoning unit. The cartoning machine 6 is configured to make a carton of cigarette packets (from cigarette packets fed into it). An example of the cartoning machine 6 is well described in patent document US2005/0005580A1 (or in the corresponding priority document BO2003A000317) which is in the name of the same Applicant as this invention and whose content (with particular regard to structure, functions and operating modes of the component parts of the machine) is incorporated herein by reference.

[0089] As to the packing machine 4, attention is also drawn to the following, with reference to a possible embodiment of it (see Figures 2 and 3, for example).

[0090] The packing machine 4 comprises a feed station 401 for feeding wrapping materials, a feed station 402 for feeding cigarettes and a packing station 400.

[0091] The feed station 401 includes one or more reservoirs of wrapping materials, which may include a first roll 403 of inner wrapping material ("inner liner"), a reservoir 404 of coupons and a second roll 405 of stiff paper material which is subjected to a succession of steps of cutting and folding to form collars ("inner frames") normally used in rigid packets. Preferably, the roll 403 is a roll of foil paper or other soft material.

[0092] With reference to cigarette feed, the feed station 402 comprises a (vertical) hopper 406 adapted to receive a mass of horizontally oriented cigarettes from the storage unit 7 at the top of it and to release the cigarettes in ordered groups G onto a drawer conveyor 407 located under the hopper 406.

[0093] As to packing, it should be noted that the packing station 403 is configured to perform the following steps (functions):

- wrapping each group G of cigarettes in an inner liner of wrapping material (foil);
- applying a collar on the inner liner placed round the group G of cigarettes;
- making the rigid outer covering by folding a flat blank S of rigid material;
- other steps, as required, such as, for example, applying coupons or tax stamps.

[0094] To carry out these steps, the packing station 400 comprises a supporting wall 408 (preferably vertical). The supporting wall 408 supports (or includes) a plurality of drive shafts 409. The drive shafts 409 are preferably horizontal (perpendicular to the supporting wall 408). The supporting wall 408 also supports (or includes) a plurality of conveyors, each connectable to a respective drive shaft 409. In an embodiment, the packing machine 4 includes a first conveyor 410, a second conveyor 411 and a third conveyor 412.

[0095] In one embodiment, the drive shafts 409 are kinematically connected to each other to ensure that the conveyors operate in phase synchrony. For this purpose, the packing machine 4 may be equipped with a grid crank system which connects the drive shafts 409 to each other and connects them to a single motor (not illustrated). An example of this system is described in Italian patent application BO97A000371.

[0096] In another embodiment, the drive shafts 409 are driven by respective, independent electric motors which are phase coordinated by a control unit.

[0097] Each conveyor 410, 411, 412 comprises a rotary support, or carousel 413, (in an example embodiment, the carousel 413 is rotatable coaxially with the respective drive shaft 409). Each conveyor 410, 411, 412 comprises a corresponding plurality of heads 414 connected to the respective carousel 413 (preferably at positions along the periphery of the respective carousel).

[0098] The heads 414 of each conveyor are configured to move into contact with a corresponding type of wrapping material intended to wrap the (ordered) groups G of

cigarettes partly or completely. The heads 414 of each conveyor 410, 411, 412 are also configured to act in conjunction with the heads 414 of at least one adjacent conveyor 410, 411, 412.

[0099] In an embodiment, the heads 414 comprise respective pockets to transport the groups G of cigarettes or the packets. In an embodiment (additionally or alternatively), the heads 414 comprise transport elements configured to transport the wrapping material. In an embodiment (additionally or alternatively), the heads 414 comprise folding elements configured to fold the wrapping material.

[0100] In an embodiment, the first conveyor 410 is located (immediately) downstream of the drawer conveyor 407 to receive from the latter a succession of groups G of cigarettes moving forward along a feed direction of the movement path P.

[0101] At an interconnecting zone between the first conveyor 410 and the drawer conveyor 407, there may be a first releasing device 415 configured to release the inner wrapping material (foil) from the first roll 403.

[0102] The heads 414 of the first conveyor 410 receive pieces of foil and successions of groups G of cigarettes and, with the aid of folding devices, wrap each group G of cigarettes completely in a piece of foil.

[0103] The first conveyor 410 is coupled to a second releasing device 416 configured to release collars, connected to the second roll 405 of rigid paper material and adapted to cut and/or punch the paper material to make a succession of collars and deliver them to the first conveyor 410. The collars are then associated with respective pieces of foil wrapped round the groups G of cigarettes.

[0104] Interposed between the second collar releasing device 416 and the respective roll 405, there may be a compensating device 417 (pneumatic, for example) whose function is to absorb irregularities in the feeding of the paper material, so that the collars are delivered to the first conveyor 410 smoothly and regularly.

[0105] Downstream of the first conveyor 410 is the second conveyor 411, which receives the groups G of cigarettes previously wrapped in the foil and which also receives blanks S of rigid material drawn from a reservoir 418 of blanks S by means of a third releasing device 419 configured to release the blanks S; the third releasing device 419 is interposed between the reservoir 418 of blanks S and the second conveyor 411 to pick up a blank S from the reservoir 418 and deliver it to the second conveyor 411.

[0106] The reservoir 418 of blanks S is adapted to contain the blanks S lying vertically and stacked horizontally. The third releasing device 419 (for releasing the blanks S) also comprises a supporting element which is rotatable about a horizontal axis and is equipped with pickup working units on its periphery.

[0107] With the aid of folding means (of known type, for example comprising curved deflectors and/or movable grippers) at least part of the blank S is folded while the group G of cigarettes dwells on the second conveyor 411.

[0108] Downstream of the second conveyor 411 is the third conveyor 412, which receives the semi-finished packet from the second conveyor 411 and folds the remaining parts of the blank S to complete the rigid packet.

[0109] Like the second conveyor 411, the third conveyor 412, too, is associated with specific folding means (of known type, for example comprising curved deflectors and/or movable grippers) adapted to fold certain parts of the packet.

[0110] Downstream of the third conveyor 412 there is a transfer device 420 configured to receive the finished packets from the packing station and send them to a storage unit ("buffer") or to another station (for example, the cellowrapping machine 5), where an outer thermoplastic film is applied to them.

[0111] In a possible embodiment, at least one of the conveyors 410, 411 and 412 can be replaced by a different type of conveyor and/or can be moved to a different position relative to the other conveyors 410, 411 and 412 and/or can be mounted on different drive shafts 409 on the supporting wall 408. This allows the conveyors 410, 411 and 412 to be redistributed and/or replaced when the size or type of packet to be made and/or the type of wrapping material to be used changes. In an embodiment, the drive shafts 409 are configured to be interchangeably coupled to each of the conveyors 410, 411 and 412. In an embodiment, at least the second and the third conveyor 411 and 412 are interchangeable, whilst the first conveyor 410 is not replaceable; in a variant embodiment, interchangeability may be extended to all the conveyors 410, 411 and 412 described above.

[0112] Interchangeability is accomplished by providing the drive shafts 409 with respective, identical connecting portions used to mount the conveyors on the drive shafts 409 in a variety of different combinations. In an embodiment, each conveyor 410, 411 and 412 is provided with a slot adapted to arbitrarily receive any of the aforementioned drive shafts 409. The shaft and the slot may be coupled to each other by a keyed connection to allow transmission of drive torque.

[0113] In an embodiment, each conveyor 410, 411 and 412 includes a transmission structure connected to the heads 414 of that conveyor to move them when the respective drive shaft 409 is driven. The transmission structure may include, for example, cam and cam follower systems or other systems of known type.

[0114] In an embodiment, the conveyors 410, 411 and 412 can be removed (for example by pulling them off the respective drive shafts 409) to be replaced by respective conveyors having different features to make packets of a different size or type (for example, rigid packets instead of soft packets).

[0115] Returning now to the line as a whole, it should be noted that the line 1 also comprises a control unit 14. The control unit 14 may be an electronic control unit.

[0116] The control unit 14 is configured to control some

or all of the machines or units (for example, the units 2, 3, 4 5, 6) forming part of the line 1.

[0117] It should be noted that the control unit 14 may be a single (or centralized) control unit or it may be a distributed control unit (that is, consisting of a plurality of modules distributed along the line 1, each dedicated to a specific function - for example, dedicated to a specific machine or unit - where the modules communicate or are coordinated with each other).

[0118] Hereinafter, for simplicity, reference is made to a machine although it is understood that the line may include a plurality of machines.

[0119] Operatively, the machine continuously processes a succession of smoking articles. Depending on circumstances (the type of machine or the stage in the process in the same machine), the smoking article may be, for example, a filter, a cigarette, an ordered group G of cigarettes or a packet of cigarettes.

[0120] The machine includes at least one working unit; in at least one embodiment, the machine includes a plurality of working units.

[0121] The working unit is a machine component which can be disconnected and removed from the machine (so it can be replaced for example). Also, in at least one embodiment, the working unit is subject to adjustment (mechanical or electronic).

[0122] Each of the heads 414 (of the conveyors 410, 411 or 412) of the packing machine 4 may constitute a working unit.

[0123] Other components that can constitute working units, as defined in this disclosure, are inter-conveyor transfer units, tensioning or traction units, foil embossing elements, collar blanking punches or other components.

[0124] In an embodiment, one or more working units are located along the movement path P of the smoking articles (production path). One or more working units might, however, also be located at a position which is spaced from the movement path P of the smoking articles. The working unit includes a tag T; that is to say, an electronic component configured to store information accessible to (readable by) an interrogation device.

[0125] In an embodiment, the tag T has a read/write memory. In an embodiment, the tag T has a data exchange interface. For example, the tag T uses RFID technology (or other short-range data transmission technology).

[0126] In at least one embodiment, the line 1 comprises a probe 10. In an embodiment, the probe 10 is configured to communicate with the tags T of the working units.

[0127] In at least one embodiment, the probe 10 is (preferably) shaped like a smoking article so it can be loaded and processed in one or more of the machines of the line 1 in the same way as a real smoking article. For example, the probe 10 may be shaped like a cigarette or a group G of cigarettes (see Figures 6 and 7, for example); in the latter case, the probe 10 may be loaded in the packing machine 4.

[0128] The probe 10 includes a processor 16 which may be integrated in an electronic card 11 (see Figure 5 for example). The probe 10 includes a memory 12; the memory 12 is preferably a read and write memory. The probe 10 includes a data exchange module 13; that is, a communication module. For example, the data exchange module 13 uses RFID technology (or other short-range data transmission technology).

[0129] In at least one embodiment, the probe 10 also includes an electric power supply 22 (battery).

[0130] In an embodiment, the tag T of the working unit is a passive RFID tag. When the probe 10 is located at an operating position along the movement path P, in proximity to the working unit, it can read the data from the tag T or write data to the tag T.

[0131] In a variant, the tag T of the working unit is powered and can in turn transmit data to the probe 10.

[0132] As to the data contained in the tag T, the memory of the tag T can contain data of various kinds, examples of which are provided below. The tag T can contain an identification code of the working unit the tag T belongs to. It should be noted that the tag T is stably and irremovably associated with the working unit. Furthermore, the tag T can contain the manufacturing date of the working unit and the identification data of the machines it has been mounted on.

[0133] The tag T can also contain dates associated with a description of an activity; for example, the dates of one or more adjustments carried out on the working unit.

[0134] The tag T can contain the values of one or more adjustment parameters set during testing or subsequent calibrations of the working unit. The nature of the adjustment depends on the type and function of the working unit; for example, if the function of the working unit is to hold a group G of cigarettes, the adjustment may involve mechanically moving the gripping elements, to ensure that the pressure applied on the group G of cigarettes (which in this case may be the adjustment parameter) is within a certain range of values - for example, specified by the manufacturer or based on checking the effective action of the working unit on the cigarette packet (obviously, the group G of cigarettes must not be subjected to excessive pressure that would damage it).

[0135] The tag T may also contain an operating time interval of the working unit. Also, the tag T may contain information regarding the type of one or more machines which the working unit has been mounted on during its working life. The tag T may also contain information regarding the position of the working unit inside one or more machines which the working unit has worked in.

[0136] The tag T may also contain diagnostic data referred to the working unit derived during a step of diagnosing the line. More generally speaking, the tag T may also contain all or part of the data contained in the control unit 14 of the line 1.

[0137] In an embodiment, the probe 10 includes a local sensor 17 (at least one or a plurality of local sensors) configured to detect an adjustment parameter of the

working unit. For example, the probe 10 might be provided with sensors configured to detect the pressure applied on the outside of it (for example, by a certain working unit).

[0138] The function of these sensors is to provide a control signal for an operator during setting up or adjustment of the working unit (for example with the machine stationary and the probe 10 coupled to the working unit or positioned in proximity thereto, depending on circumstances).

[0139] For example, if the working unit is a head 414 of the packing machine 4 and the probe 10 is shaped like a group G of cigarettes, the user can place the probe 10 in that working unit and, using the probe 10, can then read a value of the pressure (or other parameter) applied by the head 414 on the probe 10 in order to adjust the setting of the working unit (by feedback) until the pressure applied by the head 414 on the probe 10 adopts the required value (or returns within the range of values).

[0140] In an embodiment, the line 1 comprises a plurality of working units positioned in series and spaced along the movement path P. For example, the head 414 of the first conveyor 410 are (functionally) in series with the heads 414 of the second conveyor 411 and with the heads 414 of the third conveyor 412.

[0141] In the same example, the heads 414 of the plurality of heads associated with the same carousel 413 of one of the conveyors 410, 411 and 412 are (functionally) in parallel with each other.

[0142] The line 1 thus comprises a plurality of probes 10, corresponding to the plurality of working units placed in parallel with each other. That way, the probes 10 can be processed simultaneously by the machine and can come into contact or interact with (or move to the respective operating positions in the proximity of) respective working units simultaneously (or in any case without having to stop the machine). Thus, according to one aspect of this disclosure, a working unit of a production line 1 in the tobacco industry is provided.

[0143] The working unit comprises a body which is geometrically configured to removably connect the working unit to the line 1. The working unit also comprises an adjustment mechanism including at least one mechanical and/or electrical adjustment parameter detectable from outside the working unit. The working unit also comprises the tag T which has a read/write memory and a data exchange interface.

[0144] In an embodiment, the tag T is positioned on a portion of the outside surface of the body of the working unit, intended, in use, to face the probe 10 at least one operating position adopted by the probe 10 in the context of the movement (production) path P of the smoking articles in the line.

[0145] According to another aspect of the disclosure (an example of which is illustrated in Figure 4), the line 1 comprises one or more line sensors 15 configured to measure at least one machine parameter representing the operation of at least one element of the line. The control unit 14 is connected to the line sensor 15 in order to control the operation of at least one part of the line.

[0146] In an embodiment, the line includes a diagnostic probe; it may be adapted to interact with the one or more line sensors 15 when it moves through the line and the probe is processed in the same way as a smoking article.

[0147] In one embodiment (which is not described further), the diagnostic probe is distinct and separate from the probe 10 (which is an inspection probe, meaning that its function is to inspect the tags T of the working units). In another embodiment (which the disclosure will focus on, without thereby losing in generality), the same probe 10 also has (in addition to the inspection function) the diagnostic function. Hereinafter, therefore, reference is made simply to the probe 10 to include both the embodiment in which the diagnostic probe is distinct from the probe 10 and the embodiment in which the probe 10 and the diagnostic probe are one and the same.

[0148] The probe 10 is configured to acquire at least one probe parameter. The probe 10 (provided with the processor 16, the at least one local sensor 17, the memory 12, the data transmission module 13 and the power supply 22) is shaped like a smoking article, has at least one local sensor 17 and is configured to acquire at least one probe parameter.

[0149] The line 1 may include an electronic database 21 operatively in communication with the control unit 14 and with the memory 12 of the probe 10 to receive and store data acquired for the at least one machine parameter and the at least one probe parameter.

[0150] The line 1 also includes a computer 18 configured to generate an activation signal and to transmit it to the probe 10 and to the control unit 14 at a starting instant. The computer is programmed to time-correlate the data stored in the electronic database 21.

[0151] Also defined according to this disclosure, therefore, is a diagnostic method for analysing the operation of at least part of a production line 1 for making smoking articles, that is to say, one or more machines (2, 3, 4, 5, 6) making up the line 1 itself.

[0152] The method is implemented by the probe 10 through the following steps:

- generating an activation signal;
- transmitting the activation signal to the processor of the probe 10 at a starting (or activation) instant;
- transmitting the activation signal to the processor control unit 14 of the line 1 at the starting instant;
- receiving in an electronic database 21 a set of data of the probe 10 acquired from the probe 10 (at successive time instants), in response to the activation signal received, between the starting instant and an end of acquisition instant;
- receiving in the electronic database 21 a set of line data acquired by the control unit 14, in response to the activation signal received, between the starting instant and the end of acquisition instant;
- time-correlating the data sets of the probe and of the line.

[0153] It should be noted that the line data comprises a data set representing at least one machine parameter. According to another aspect, the method further comprises a step of transmitting a stop signal to the processor of the probe 10 and to the control unit of the line 1 at the end of acquisition instant, which causes acquisition of probe and line data to stop.

[0154] It should be noted that the electronic appliance 19 preferably comprises a (hardware and/or software) module for communication with the probe 10 and a (hardware and/or software) module for communication with the control unit 14. The electronic appliance 19 may also comprise a data analysis module configured to statistically analyse the line data and the probe data which have been time-phased (correlated) with each other beforehand.

[0155] It should be noted, more generally speaking, that the electronic appliance 19 is provided with a user interface (enabling a user to issue commands) a memory and a display.

[0156] Preferably, the time-correlation step comprises, for each item of the probe data set, setting in relation to each other a synchronization parameter value referred to the starting instant and assigned to that data item, and a corresponding reference instant assigned to at least one respective item of the line data set.

[0157] According to another aspect, the method comprises, after the step of transmitting the activation signal to the processor of the probe 10 at a "starting "(or activation) instant, the step of acquiring (preferably at a predetermined sampling interval) the values of the probe parameters. According to another aspect, the method comprises a step of acquiring the aforementioned line data, following the step of transmitting the activation signal.

[0158] In an embodiment, the line parameters comprise parameters representing a position occupied at a given instant by one or more conveyor units configured to move the smoking articles (and the probe) along at least part of the line 1. This means that analysing the (line) parameter over time allows the position of the probe 10 (which is moved by, or as one with, the one or more conveyor units) to be traced with a high degree of precision and accuracy.

[0159] It should be noted, more generally speaking, that the line parameters are used to identify the state or configuration of a machine at a given instant.

[0160] According to another aspect, the control unit 14 of the line 1 comprises a clock and is programmed to associate with each data item it acquires a reference instant referred to the starting instant. Preferably, the probe 10 comprises a synchronizer configured to generate a synchronization signal referred to the starting instant and the processor 16 of the probe 10 is programmed to associate a value of the synchronization parameter with each data item acquired by the probe 10.

[0161] In other words, it should be noted that the clock of the control unit 14 and the synchronizer are used to assign a time instant to each probe and line data sample, starting from the same starting instant.

[0162] The probe 10 also has a base element or frame (externally shaped like the smoking article) which houses the electronic card 11.

[0163] It should be noted that according to at least one aspect of this disclosure, a very precise diagnosis can be performed on the machine because knowing the position of the probe 10 means that malfunctions and/or faults can be located very precisely.

[0164] It should be noted that the probe 10 can be processed in the same way as an ordinary product; in this sense, the probe 10 may be subjected to the same physical phenomena (impact, compression, acceleration, heating) and undergoes the same processes as a product of the same type.

[0165] The method according to any one of the preceding claims, wherein the probe (10) communicates wirelessly with the control unit (14) and is driven by the latter in real time.

[0166] As regards adjustment of the working units, the possible diagnostic function of the probe 10 interacts synergically with its inspection function. In effect, the fact that the probe 10 can read data from, and write data to, the tag T of the working unit means that the adjustment parameter values previously set in the working unit can be retrieved from the memory and the new values set following the (new) adjustment can be written to the memory.

[0167] According to one aspect of it, this disclosure provides a diagnostic method for inspecting at least part of the line 1 (for example, one or more of the machines or units 2, 3, 4, 5, 6 of the line 1).

[0168] The method comprises storing specific data in the tag T of the working unit. These data preferably represent constructional or operating specifications of the working unit and may represent adjustments or settings carried out on the working unit over time; in an embodiment, the data stored in the tag T keep track of the operation of the working unit over time; in an embodiment, the data stored in the tag T form a "track record", that is, a file or a "fingerprint", representing the history of that working unit starting from the time it was manufactured.

[0169] The inspection method includes a step of reading the data contained in the tag T of the working unit (for one or more of the working units of the line 1). The method also comprises a step of transferring data to and from the tag T of the working unit.

[0170] In an embodiment, this step of reading comprises loading the probe 10 into the line 1 at a loading position located along the movement path P of the smoking articles. In this embodiment, the step of transferring data between the probe and the tag T of the working unit is carried out when the probe is located at an operating position along the movement path P.

[0171] In an embodiment, the machine (or line 1) is made to process the probe 10 and data are read from one or more working units in succession as the probe

advances along the movement path P. More specifically, the same probe 10 reads all the tags T of the working units located along the movement path P and functionally positioned in series with each other. Reading a plurality of tags T of working units which are functionally positioned in parallel with each other (for example, the heads 414 of a single carousel 413 in the packing machine 4), involves loading in the machine a succession of probes 10 equal in number to the number of working units of the plurality of working units positioned in parallel.

[0172] In an embodiment, during the step of exchanging data with the working unit, the probe 10 may be held still at the operating position. This solution is particularly advantageous if data exchange between the tag T of the working unit and the probe 10 is carried out during, or for the purposes of, adjustment of the working unit.

[0173] In this context, the (inspection) method may comprise a procedure of checking the working unit through the following steps:

- reading the memory of the working unit tag by the probe 10 to derive reference data (for example, ranges of values provided by the manufacturer or historical values of one or more adjustment parameters set during a previous step of adjusting carried out on the working unit);
- detecting, by the probe, of the current values of the one or more working unit adjustment parameters;
- comparing the historical values with the current values of the one or more working unit adjustment parameters.

[0174] In an embodiment, the probe 10 communicates wirelessly with the control unit 14 or with the electronic device 18, preferably in real time.

[0175] In an embodiment, the probe 10 is driven by the control unit 14 or by the electronic device 18, preferably in real time.

Claims

1. A method for inspecting the operation of at least part of a production line (1) in the tobacco industry by means of a probe (10) having the shape of a smoking article and including a processor (16), a memory (12), a data exchange module (13) and an electrical power supply (22), wherein the line (1) includes a path (P) for the movement of the smoking articles, a control unit (14) and a working unit which is positioned along the movement path (P) and is provided with a tag (T) having a read/write memory and a data exchange interface to emit and receive data in a wireless communication,
the method comprising the following steps:

    - loading the probe (10) into the line (1) at a loading position located along the movement path (P);
    - transferring data between the probe (10) and the tag (T) of the working unit when the probe (10) is located at an operating position along the movement path (P).

2. The method according to claim 1, comprising a step of feeding the probe (10) along the movement path (P), wherein the loading position is located upstream of the operating position, along the movement path (P).

3. The method according to claim 1, wherein the probe (10) reads and/or writes data relating to one or more items of the list below to and from the memory of the working unit tag (T):

    - working unit identification code;
    - date of working unit manufacture;
    - date of one or more adjustments carried out on the working unit;
    - values of one or more adjustment parameters set during one or more adjustments carried out on the working unit;
    - date of activation of the probe (10);
    - operating time interval of the working unit;
    - type of one or more machines (2, 3, 4, 5 or 6) which the working unit has worked in;
    - position of the working unit inside one or more machines (2, 3, 4, 5 or 6) which the working unit has worked in;
    - diagnostic data referred to the working unit derived during a step of diagnosing the line (1);
    - one or more of the data items contained in the control unit (14) of the line (1).

4. The method according to any one of the preceding claims, wherein the probe (10) includes at least one local sensor (17) and, through that sensor (10), detects an adjustment parameter of the working unit and transmits it to the control unit (14) during a step of adjusting the working unit.

5. The method according to claim 4, wherein the probe (10), during the step of adjusting the working unit, is held still at the operating position, or is slowed down as it moves along the movement path (P).

6. The method according to claim 4 or 5, comprising a step of checking the working unit through the following steps:

    - reading the memory of the working unit tag (T) by the probe (10) to derive historical values of one or more adjustment parameters set during a previous step of adjusting carried out on the working unit;
    - detecting, by the probe (10), of the current val-

ues of the one or more working unit adjustment parameters;
- comparing the historical values with the current values of the one or more working unit adjustment parameters.

7. The method according to any one of the preceding claims, wherein the working unit is adjustable by setting one or more electrical or mechanical adjustment parameters and is removable from the line (1).

8. The method according to any one of the preceding claims, wherein the line (1) comprises a plurality of working units, positioned in series and spaced along the movement path (P), and wherein the probe (10), as it moves along the movement path (P), interacts by data transfer with the tags (T) of the working units of the plurality, one after the other.

9. The method according to any one of the preceding claims, wherein the line (1) comprises a plurality of working units, positioned in parallel to define a corresponding plurality of distinct movement paths (P) for the smoking articles, and wherein the method comprises:

- loading a corresponding plurality of probes (10) into the line (1);
- simultaneously or substantially simultaneously feeding the probes (10) along the respective movement paths (P);
- for each probe (10), transferring data between the probe and the tag (T) of the respective working unit when the probe (10) is located at a corresponding operating position along the movement path (P).

10. The method according to any one of the preceding claims, wherein the probe (10) communicates wirelessly with the control unit (14).

11. A production line (1) in the tobacco industry, comprising:

- a machine (2, 3, 4, 5 or 6) for continuously processing a succession of smoking articles including a working unit, which is positioned along a movement path (P) of the smoking articles and which includes a tag (T) having a read/write memory and a data exchange interface;
- a control unit (14);
- a probe (10) made in the shape of a smoking article and including a processor (16), a memory (12), a data exchange module (13) and an electric power supply (22),
wherein the data exchange interface of the tag (T) and the data exchange module (13) of the probe (10) are configured to transfer data between the probe (10) and the working unit tag (T), at an operating position of the probe (10) along the movement path (P).

12. The line (1) according to claim 11, wherein the memory of the working unit tag (T) contains data relating to one or more items of the list below:

- working unit identification code;
- date of working unit manufacture;
- date of one or more adjustments carried out on the working unit;
- values of one or more adjustment parameters set during one or more adjustments carried out on the working unit;
- operating time interval of the working unit;
- type of one or more machines which the working unit has worked in;
- position of the working unit inside one or more machines which the working unit has worked in;
- diagnostic data referred to the working unit derived during a step of diagnosing the line (1);
- one or more of the data items contained in the control unit (14) of the line (1).

13. The line (1) according to claim 11 or 12, wherein the probe (10) includes at least one local sensor (17) configured to detect an adjustment parameter of the working unit.

14. The line according to any one of the preceding claims 11 to 13, wherein the working unit is adjustable by setting one or more electrical or mechanical adjustment parameters and is removable from the line (1).

15. The line (1) according to any one of claims 11 to 14, wherein the line (1) comprises a plurality of working units positioned in series and spaced along the movement path (P).

16. The line (1) according to any one of claims 11 to 15, wherein the line (1) comprises a plurality of working units, positioned on a carousel (413) to define a corresponding plurality of distinct movement paths (P) for the smoking articles.

17. A working unit of a production line (1) in the tobacco industry, comprising:

- a body which is geometrically configured to removably connect the working unit to the line;
- an adjustment mechanism including at least one mechanical and/or electrical adjustment parameter detectable from outside the working unit;
- a tag (T) having a read/write memory and a data exchange interface.

18. The working unit according to claim 17, wherein the memory of the tag (T) contains data relating to one or more items of the list below:

- working unit identification code;
- date of working unit manufacture;
- date of one or more adjustments carried out on the working unit;
- values of one or more adjustment parameters set during one or more adjustments carried out on the working unit;
- operating time interval of the working unit;
- type of one or more machines which the working unit has worked in;
- position of the working unit inside one or more machines which the working unit has worked in;
- diagnostic data referred to the working unit derived during a step of diagnosing the line (1);
- one or more of the data items contained in the control unit (14) of the line (1).

19. The working unit according to claim 17 or 18, wherein the tag (T) is positioned on a portion of the outside surface of the body of the working unit, intended, in use, to face a movement path (P) of the smoking articles in the line (1).

20. The working unit according to any one of claims 17 to 19, wherein the working unit is a head (414) of a cigarette packing machine (4).

Patentansprüche

1. Verfahren zur Inspektion des Betriebs von mindestens einem Teil einer Fertigungslinie (1) in der Tabakindustrie mittels einer Sonde (10), aufweisend die Form eines Rauchartikels und einschließend einen Prozessor (16), einen Speicher (12), ein Datenaustauschmodul (13) und eine Stromversorgung (22), wobei die Linie (1) einen Weg (P) für die Bewegung des Rauchartikels, eine Steuereinheit (14) und eine Arbeitseinheit einschließt, die entlang des Bewegungswegs (P) positioniert und mit einem Tag (T) versehen ist, aufweisend einen Lese-/Schreibspeicher und eine Datenaustauschschnittstelle, um Daten in einer drahtlosen Kommunikation auszugeben und zu empfangen, wobei das Verfahren die folgenden Schritte umfasst:

- Laden der Sonde (10) in die Linie (1) an einer Ladeposition, die entlang des Bewegungswegs (P) positioniert ist;
- Transferieren von Daten zwischen der Sonde (10) und dem Tag (T) der Arbeitseinheit, wenn sich die Sonde (10) an einer Betriebsposition entlang des Bewegungswegs (P) befindet.

2. Verfahren nach Anspruch 1, umfassend einen Schritt zum Zuführen der Sonde (10) entlang des Bewegungswegs (P), wobei die Ladeposition vor der Betriebsposition entlang des Bewegungswegs (P) angeordnet ist.

3. Verfahren nach Anspruch 1, wobei die Sonde (10) Daten, die sich auf ein oder mehrere Elemente der Liste unten beziehen, in den Speicher des Tags (T) der Arbeitseinheit schreibt oder aus diesem ausliest:

- Identifizierungscode der Arbeitseinheit;
- Herstellungsdatum der Arbeitseinheit;
- Daten von einer oder mehreren Einstellungen, die an der Arbeitseinheit durchgeführt wurden;
- Werte von einem oder mehreren Einstellungsparametern, die während einer oder mehrerer Einstellungen, die an der Arbeitseinheit durchgeführt wurden, festgelegt wurden;
- Datum der Aktivierung der Sonde (10);
- Betriebszeitintervall der Arbeitseinheit;
- Typ von einer oder mehreren Maschinen (2, 3, 4, 5 oder 6), in der/denen die Arbeitseinheit gearbeitet hat;
- Position der Arbeitseinheit in einer oder mehreren Maschinen (2, 3, 4, 5 oder 6), in der/denen die Arbeitseinheit gearbeitet hat;
- Diagnosedaten, bezogen auf die Arbeitseinheit, abgeleitet während eines Schritts zur Diagnose der Linie (1);
- ein oder mehrere der Datenelemente, die in der Steuereinheit (14) der Linie (1) enthalten sind.

4. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Sonde (10) mindestens einen lokalen Sensor (17) einschließt und durch diesen Sensor (10) während eines Schritts zum Einstellen der Arbeitseinheit einen Einstellungsparameter der Arbeitseinheit erfasst und an die Steuereinheit (14) übermittelt.

5. Verfahren nach Anspruch 4, wobei die Sonde (10) während des Schritts zum Einstellen der Arbeitseinheit stillstehend an der Betriebsposition gehalten oder verlangsamt wird, wenn sie sich entlang des Bewegungswegs (P) bewegt.

6. Verfahren nach Anspruch 4 oder 5, umfassend einen Schritt zum Prüfen der Arbeitseinheit durch die folgenden Schritte:

- Lesen des Speichers des Tags (T) der Arbeitseinheit durch die Sonde (10), um Historienwerte von einem oder mehreren Einstellungsparametern abzuleiten, die während eines vorherigen Schritts zum Einstellen festgelegt wurden, der auf der Arbeitseinheit ausgeführt wurde;

- Erfassen der Istwerte des einen oder der mehreren Einstellungsparameter der Arbeitseinheit durch die Sonde (10);
- Vergleichen der Historienwerte mit den Istwerten des einen oder der mehreren Einstellungsparameter der Arbeitseinheit.

7. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Arbeitseinheit einstellbar ist, indem ein oder mehrere elektrische oder mechanische Einstellparameter festgelegt werden, und von der Linie (1) entfernbar ist.

8. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Linie (1) eine Vielzahl von Arbeitseinheiten umfasst, die in Reihe positioniert und entlang des Bewegungswegs (P) beabstandet sind, und wobei die Sonde (10) während ihrer Bewegung entlang des Bewegungswegs (P) durch Datentransfer mit den Tags (T) der Arbeitseinheiten der Vielzahl nacheinander interagiert.

9. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Linie (1) eine Vielzahl von Arbeitseinheiten umfasst, die parallel positioniert sind, um eine entsprechende Vielzahl von unterschiedlichen Bewegungswegen (P) für die Rauchartikel zu definieren, wobei das Verfahren Folgendes umfasst:

- Laden einer entsprechenden Vielzahl von Sonden (10) in die Linie (1);
- gleichzeitiges oder im Wesentlichen gleichzeitiges Zuführen der Sonden (10) entlang der jeweiligen Bewegungswege (P);
- für jede Sonde (10) Transferieren von Daten zwischen der Sonde und dem Tag (T) der jeweiligen Arbeitseinheit, wenn sich die Sonde (10) an einer entsprechenden Betriebsposition entlang des Bewegungswegs (P) befindet.

10. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Sonde (10) drahtlos mit der Steuereinheit (14) kommuniziert.

11. Fertigungslinie (1) in der Tabakindustrie, umfassend:

- eine Maschine (2, 3, 4, 5 oder 6) für das durchgehende Verarbeiten einer Abfolge von Rauchartikeln, einschließend eine Arbeitseinheit, die entlang eines Bewegungswegs (P) der Rauchartikel positioniert ist, und die ein Tag (T) einschließt, aufweisend einen Lese-/Schreibspeicher und eine Datenaustauschschnittstelle;
- eine Steuereinheit (14);
- eine Sonde (10), ausgebildet in der Form eines Rauchartikels und einschließend einen Prozessor (16), einen Speicher (12), ein Datenaustauschmodul (13) und eine Stromversorgung (22),

wobei die Datenaustauschschnittstelle des Tags (T) und das Datenaustauschmodul (13) der Sonde (10) ausgelegt sind, um Daten zwischen der Sonde (10) und dem Tag der Arbeitseinheit (T) an einer Betriebsposition der Sonde (10) entlang des Bewegungswegs (P) zu transferieren.

12. Linie (1) nach Anspruch 11, wobei der Speicher des Tags (T) der Arbeitseinheit Daten enthält, die sich auf ein oder mehrere Elemente der Liste unten beziehen:

- Identifizierungscode der Arbeitseinheit;
- Herstellungsdatum der Arbeitseinheit;
- Daten von einer oder mehreren Einstellungen, die an der Arbeitseinheit durchgeführt wurden;
- Werte von einem oder mehreren Einstellungsparametern, die während einer oder mehrerer Einstellungen, die an der Arbeitseinheit durchgeführt wurden, festgelegt wurden;
- Betriebszeitintervall der Arbeitseinheit;
- Typ von einer oder mehreren Maschinen, in der/denen die Arbeitseinheit gearbeitet hat;
- Position der Arbeitseinheit in einer oder mehreren Maschinen, in der/denen die Arbeitseinheit gearbeitet hat;
- Diagnosedaten, bezogen auf die Arbeitseinheit, abgeleitet während eines Schritts zur Diagnose der Linie (1);
- ein oder mehrere der Datenelemente, die in der Steuereinheit (14) der Linie (1) enthalten sind.

13. Linie (1) nach Anspruch 11 oder 12, wobei die Sonde (10) mindestens einen lokalen Sensor (17) einschließt, der ausgelegt ist, um einen Einstellungsparameter der Arbeitseinheit zu erfassen.

14. Linie nach einem der Ansprüche 11 bis 13, wobei die Arbeitseinheit einstellbar ist, indem ein oder mehrere elektrische oder mechanische Einstellparameter festgelegt werden, und von der Linie (1) entfernbar ist.

15. Linie (1) nach einem der Ansprüche 11 bis 14, wobei die Linie (1) eine Vielzahl von Arbeitseinheiten umfasst, die in Reihe positioniert und entlang des Bewegungswegs (P) beabstandet sind.

16. Linie (1) nach einem der Ansprüche 11 bis 15, wobei die Linie (1) eine Vielzahl von Arbeitseinheiten umfasst, die auf einem Karussell (413) positioniert sind, um eine entsprechende Vielzahl von unterschiedlichen Bewegungswegen (P) für die Rauchartikel zu definieren.

17. Arbeitseinheit einer Fertigungslinie (1) in der Tabakindustrie, umfassend:

- ein Gehäuse, das geometrisch ausgelegt ist, um die Arbeitseinheit entfernbar mit der Linie zu verbinden;
- ein Einstellmechanismus, einschließend mindestens einen mechanischen und/oder elektrischen Einstellparameter, der von außerhalb der Arbeitseinheit erfassbar ist;
- ein Tag (T), aufweisend einen Lese-/Schreibspeicher und eine Datenaustauschschnittstelle.

18. Arbeitseinheit nach Anspruch 17, wobei der Speicher des Tags (T) Daten enthält, die sich auf ein oder mehrere Elemente der Liste unten beziehen:

- Identifizierungscode der Arbeitseinheit;
- Herstellungsdatum der Arbeitseinheit;
- Daten von einer oder mehreren Einstellungen, die an der Arbeitseinheit durchgeführt wurden;
- Werte von einem oder mehreren Einstellungsparametern, die während einer oder mehrerer Einstellungen, die an der Arbeitseinheit durchgeführt wurden, festgelegt wurden;
- Betriebszeitintervall der Arbeitseinheit;
- Typ von einer oder mehreren Maschinen, in der/denen die Arbeitseinheit gearbeitet hat;
- Position der Arbeitseinheit in einer oder mehreren Maschinen, in der/denen die Arbeitseinheit gearbeitet hat;
- Diagnosedaten, bezogen auf die Arbeitseinheit, abgeleitet während eines Schritts zur Diagnose der Linie (1);
- ein oder mehrere der Datenelemente, die in der Steuereinheit (14) der Linie (1) enthalten sind.

19. Arbeitseinheit nach Anspruch 17 oder 18, wobei das Tag (T) auf einem Abschnitt der außenseitigen Oberfläche des Gehäuses der Arbeitseinheit positioniert ist, ausgelegt, um in Verwendung einem Bewegungsweg (P) der Rauchartikel in der Linie (1) zugewandt zu sein.

20. Arbeitseinheit nach einem der Ansprüche 17 bis 19, wobei die Arbeitseinheit ein Kopfteil (414) einer Zigarettenverpackungsmaschine (4) ist.

Revendications

1. Procédé d'inspection du fonctionnement d'au moins une partie d'une ligne de production (1), dans l'industrie du tabac, au moyen d'une sonde (10) ayant la forme d'un article à fumer et incluant un processeur (16), une mémoire (12), un module d'échange de données (13) et une alimentation électrique (22), dans lequel la ligne (1) comprend un parcours (P) destiné au déplacement des articles à fumer, une unité de commande (14) et une unité de travail étant positionnée le long du parcours de déplacement (P) et étant munie d'une balise (T) ayant une mémoire de lecture/écriture et une interface d'échange de données pour émettre et recevoir des données dans une communication sans fil,
le procédé comprenant les étapes suivantes :

- charger la sonde (10) dans la ligne (1) en correspondance d'une position de chargement située le long du parcours de déplacement (P) ;
- transférer des données entre la sonde (10) et la balise (T) de l'unité de travail lorsque la sonde (10) est située en correspondance d'une position de fonctionnement le long du parcours de déplacement (P).

2. Procédé selon la revendication 1, comprenant une étape consistant à alimenter la sonde (10) le long du parcours de déplacement (P), dans lequel la position de chargement est située en amont de la position de fonctionnement, le long du parcours de déplacement (P).

3. Procédé selon la revendication 1, dans lequel la sonde (10) lit et/ou écrit des données relatives à un ou plusieurs éléments de la liste ci-dessous sur et à partir de la mémoire de la balise (T) de l'unité de travail :

- code d'identification de l'unité de travail ;
- date de fabrication de l'unité de travail ;
- date d'un ou plusieurs réglages effectués sur l'unité de travail ;
- valeurs d'un ou de plusieurs paramètres de réglage établis lors d'un ou plusieurs réglages effectués sur l'unité de travail ;
- date d'activation de la sonde (10) ;
- intervalle de temps de fonctionnement de l'unité de travail ;
- type d'une ou plusieurs machines (2, 3, 4, 5 ou 6) dans lesquelles l'unité de travail a travaillé ;
- position de l'unité de travail à l'intérieur d'une ou plusieurs machines (2, 3, 4, 5 ou 6) dans lesquelles l'unité de travail a travaillé ;
- données de diagnostic relatives à l'unité de travail obtenues lors d'une étape de diagnostic de la ligne (1) ;
- un ou plusieurs des éléments d'information contenus dans l'unité de commande (14) de la ligne (1).

4. Procédé selon l'une quelconque des revendications précédentes, dans lequel la sonde (10) inclut au moins un capteur local (17) et, par l'intermédiaire de ce capteur (10), détecte un paramètre de réglage de

l'unité de travail et le transmet à l'unité de commande (14) pendant une étape de réglage de l'unité de travail.

5. Procédé selon la revendication 4, dans lequel la sonde (10), pendant l'étape de réglage de l'unité de travail, est maintenue immobile en position de fonctionnement, ou est ralentie lorsqu'elle se déplace le long du parcours de déplacement (P).

6. Procédé selon la revendication 4 ou 5, comprenant une étape de vérification de l'unité de travail à travers les étapes suivantes :

- lire la mémoire de la balise (T) de l'unité de travail par la sonde (10) pour tirer des valeurs historiques d'un ou plusieurs paramètres de réglage réglés lors d'une étape précédente de réglage effectuée sur l'unité de travail ;
- détecter, par la sonde (10), des valeurs actuelles d'un ou plusieurs paramètres de réglage de l'unité de travail ;
- comparer les valeurs historiques avec les valeurs actuelles d'un ou plusieurs paramètres de réglage de l'unité de travail.

7. Procédé selon l'une quelconque des revendications précédentes, dans lequel l'unité de travail est réglable en réglant un ou plusieurs paramètres de réglage électriques ou mécaniques et peut être retirée de la ligne (1).

8. Procédé selon l'une quelconque des revendications précédentes, dans lequel la ligne (1) comprend une pluralité d'unités de travail, positionnées en série et espacées le long du parcours de déplacement (P), et dans lequel la sonde (10), lorsqu'elle se déplace le long du parcours de déplacement (P), interagit par transfert de données avec les balises (T) des unités de travail de la pluralité, l'une après l'autre.

9. Procédé selon l'une quelconque des revendications précédentes, dans lequel la ligne (1) comprend une pluralité d'unités de travail, positionnées en parallèle pour définir une pluralité correspondante de parcours de déplacement (P) distincts pour les articles à fumer, et dans lequel le procédé comprend :

- charger une pluralité correspondante de sondes (10) dans la ligne (1) ;
- alimenter simultanément ou de façon substantiellement simultanée les sondes (10) le long des parcours de déplacement (P) respectifs ;
- pour chaque sonde (10), transférer des données entre la sonde et la balise (T) de l'unité de travail respective lorsque la sonde (10) est située à une position de fonctionnement correspondante le long du parcours de déplacement (P).

10. Procédé selon l'une quelconque des revendications précédentes, dans lequel la sonde (10) communique sans fil avec l'unité de commande (14).

11. Ligne de production (1) dans l'industrie du tabac, comprenant :

- une machine (2, 3, 4, 5 ou 6) destinée au traitement en continu d'une succession d'articles à fumer, incluant une unité de travail étant positionnée le long d'un parcours (P) de déplacement des articles à fumer et qui inclut une balise (T) comportant une mémoire de lecture/écriture et une interface d'échange de données ;
- une unité de commande (14) ;
- une sonde (10) réalisée sous la forme d'un article à fumer et incluant un processeur (16), une mémoire (12), un module d'échange de données (13) et une alimentation électrique (22),

dans laquelle l'interface d'échange de données de la balise (T) et le module d'échange de données (13) de la sonde (10) sont configurés pour transférer des données entre la sonde (10) et la balise (T) de l'unité de travail, en correspondance d'une position de fonctionnement de la sonde (10) le long du parcours de déplacement (P).

12. Ligne (1) selon la revendication 11, dans laquelle la mémoire de la balise (T) de l'unité de travail contient des données relatives à un ou plusieurs éléments de la liste ci-dessous :

- code d'identification de l'unité de travail ;
- date de fabrication de l'unité de travail ;
- date d'un ou plusieurs réglages effectués sur l'unité de travail ;
- valeurs d'un ou de plusieurs paramètres de réglage établis lors d'un ou plusieurs réglages effectués sur l'unité de travail ;
- intervalle de temps de fonctionnement de l'unité de travail ;
- type d'une ou plusieurs machines dans lesquelles l'unité de travail a travaillé ;
- position de l'unité de travail à l'intérieur d'une ou de plusieurs machines dans lesquelles l'unité de travail a travaillé ;
- données de diagnostic relatives à l'unité de travail obtenues lors d'une étape de diagnostic de la ligne (1) ;
- un ou plusieurs des éléments d'information contenus dans l'unité de commande (14) de la ligne (1).

13. Ligne (1) selon la revendication 11 ou 12, dans laquelle la sonde (10) inclut au moins un capteur local

(17) configuré pour détecter un paramètre de réglage de l'unité de travail.

14. Ligne selon l'une quelconque des revendications précédentes 11 à 13, dans laquelle l'unité de travail est réglable en réglant un ou plusieurs paramètres de réglage électriques ou mécaniques et peut être retirée de la ligne (1).

15. Ligne (1) selon l'une quelconque des revendications 11 à 14, dans laquelle la ligne (1) comprend une pluralité d'unités de travail positionnées en série et espacées le long du parcours de déplacement (P).

16. Ligne (1) selon l'une quelconque des revendications 11 à 15, dans laquelle la ligne (1) comprend une pluralité d'unités de travail positionnées sur un carrousel (413) pour définir une pluralité correspondante de parcours de déplacement (P) distincts pour les articles à fumer.

17. Unité de travail d'une ligne de production (1) dans l'industrie du tabac, comprenant :

- un corps étant configuré géométriquement pour relier de manière amovible l'unité de travail à la ligne ;
- un mécanisme de réglage incluant au moins un paramètre de réglage mécanique et/ou électrique détectable de l'extérieur de l'unité de travail ;
- une balise (T) ayant une mémoire de lecture/écriture et une interface d'échange de données.

18. Unité de travail selon la revendication 17, dans laquelle la mémoire de la balise (T) contient des données relatives à un ou plusieurs éléments de la liste ci-dessous :

- code d'identification de l'unité de travail ;
- date de fabrication de l'unité de travail ;
- date d'un ou plusieurs réglages effectués sur l'unité de travail ;
- valeurs d'un ou de plusieurs paramètres de réglage établis lors d'un ou plusieurs réglages effectués sur l'unité de travail ;
- intervalle de temps de fonctionnement de l'unité de travail ;
- type d'une ou plusieurs machines dans lesquelles l'unité de travail a travaillé ;
- position de l'unité de travail à l'intérieur d'une ou de plusieurs machines dans lesquelles l'unité de travail a travaillé ;
- données de diagnostic relatives à l'unité de travail obtenues lors d'une étape de diagnostic de la ligne (1) ;
- un ou plusieurs des éléments d'information contenus dans l'unité de commande (14) de la ligne (1).

19. Unité de travail selon la revendication 17 ou 18, dans laquelle la balise (T) est positionnée sur une partie de la surface extérieure du corps de l'unité de travail, prévue, en fonctionnement, pour faire face à un parcours de déplacement (P) des articles à fumer de la ligne (1).

20. Unité de travail selon l'une quelconque des revendications 17 à 19, dans laquelle l'unité de travail est une tête (414) d'une machine d'emballage (4) de cigarettes.

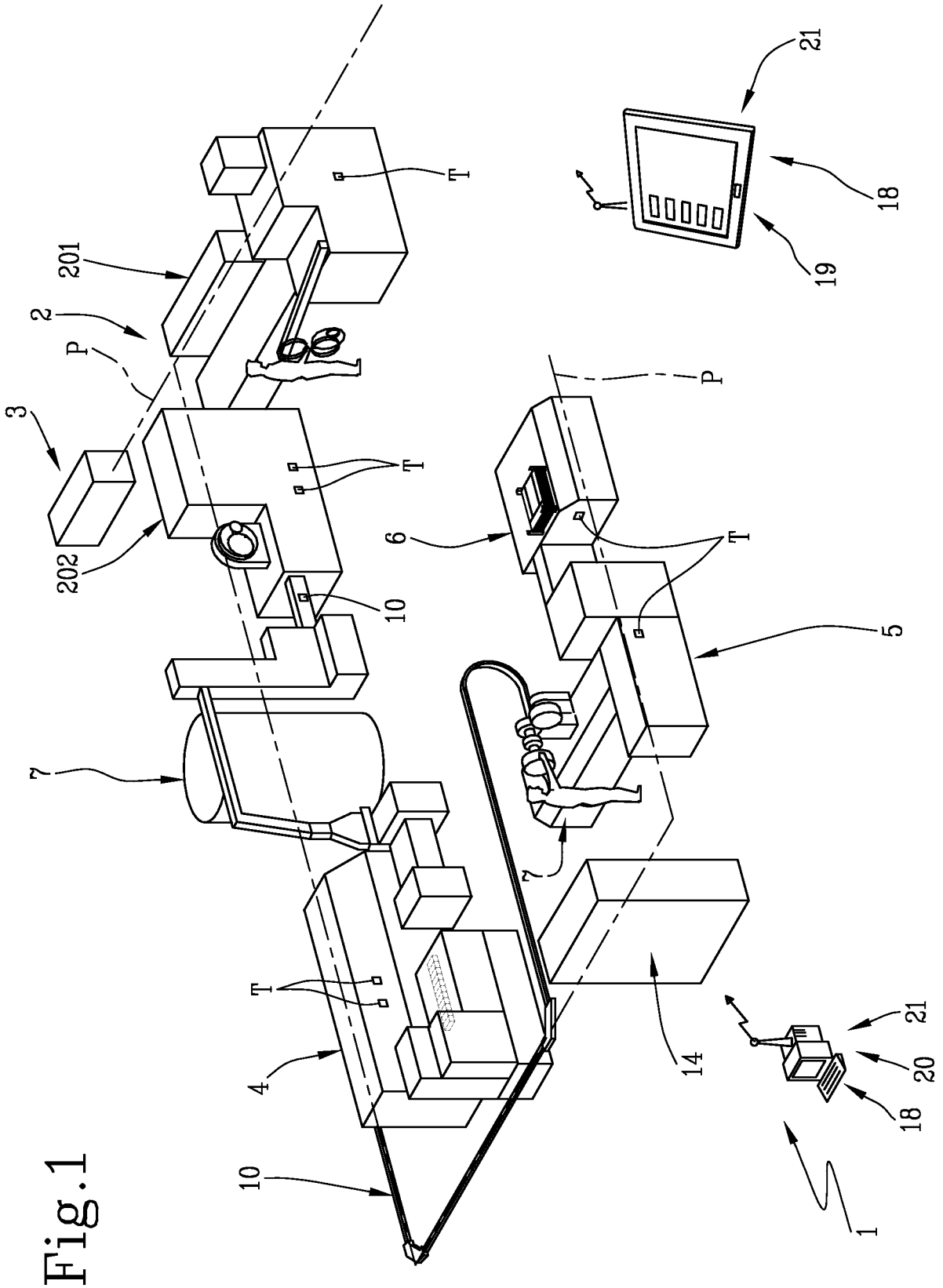

Fig.1

Fig.2

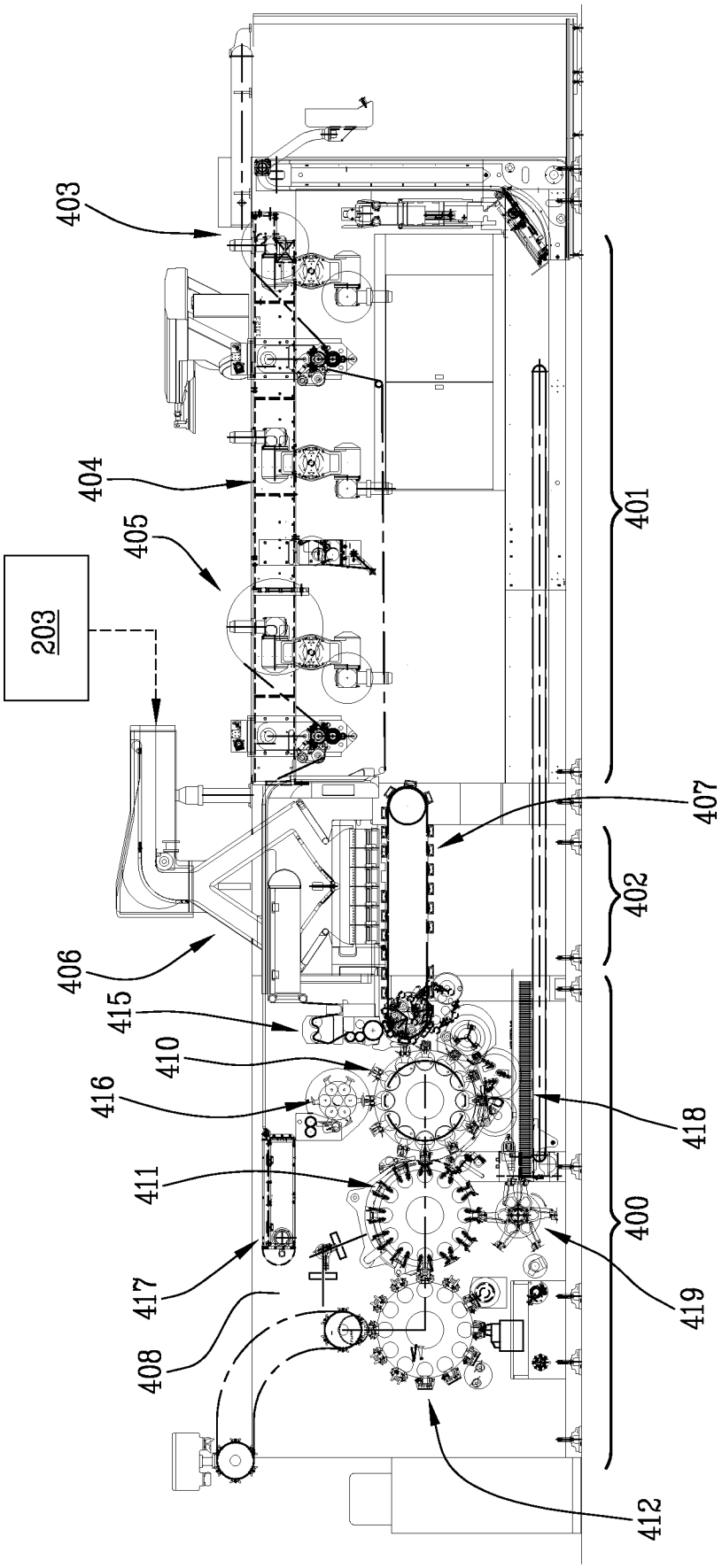
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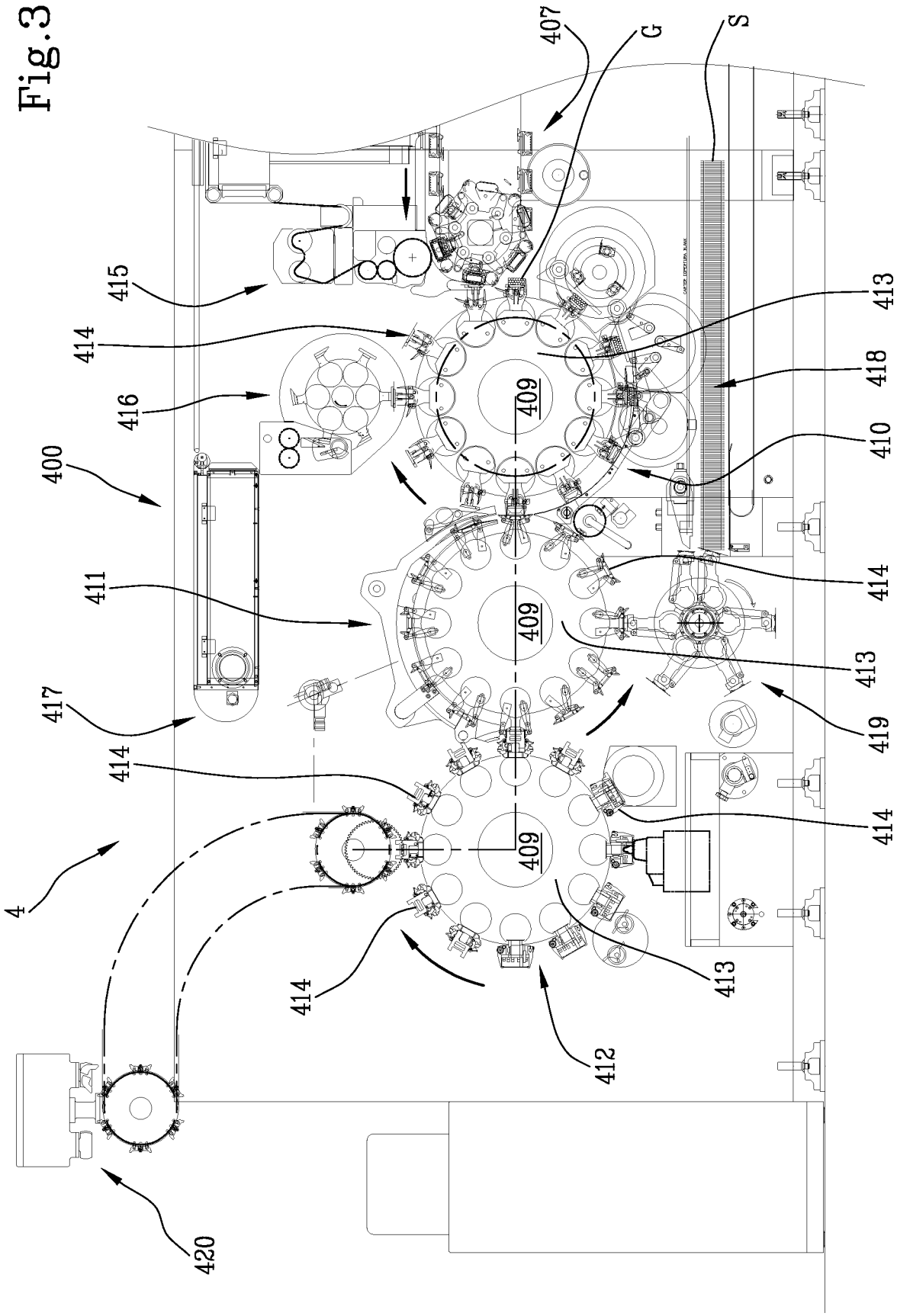
Fig.3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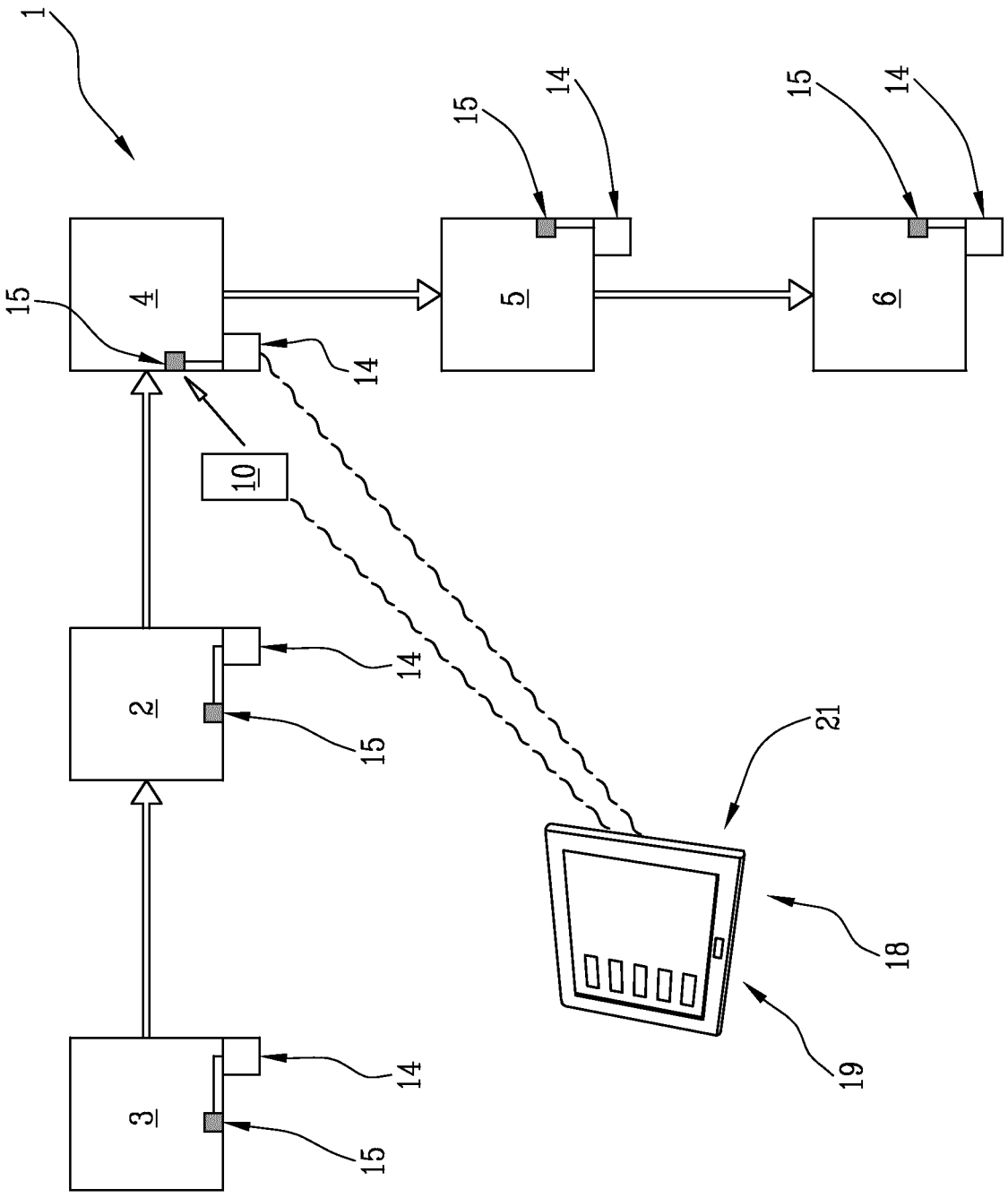


Fig.4

Fig.5

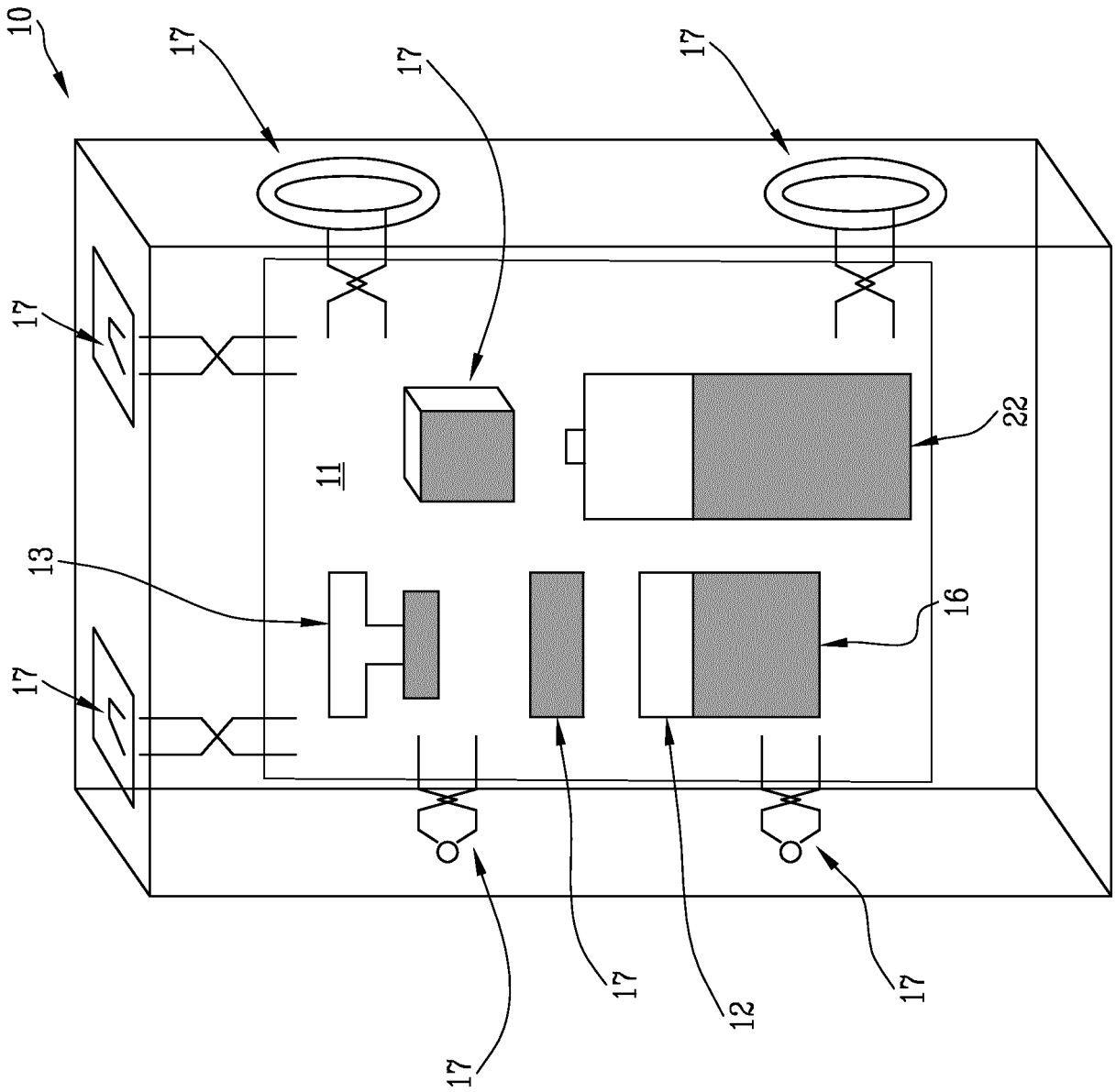


Fig.7

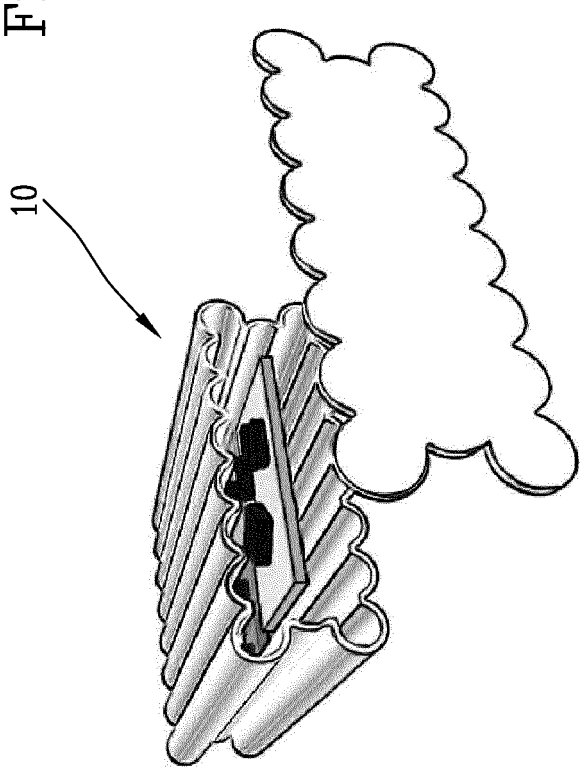
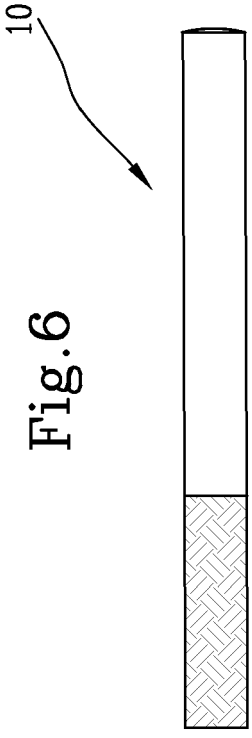


Fig.6



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