



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.07.2021 Bulletin 2021/29

(21) Application number: **21151602.6**

(22) Date of filing: **14.01.2021**

(51) Int Cl.:
B24B 9/00 (2006.01) **B24B 9/06 (2006.01)**
B24B 9/10 (2006.01) **B24B 27/00 (2006.01)**
B24B 47/22 (2006.01) **B24B 49/10 (2006.01)**
B24B 49/16 (2006.01) **B24B 47/26 (2006.01)**
B24B 49/18 (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
KH MA MD TN

(30) Priority: **17.01.2020 IT 202000000829**

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(54) **A RECTIFYING SYSTEM FOR SQUARING MACHINES, SQUARING MACHINE AND CONTROL METHOD THEREOF**

(57) A rectifying system (25) for slab squaring machines which comprises:

- a rectifying machine (250) comprising:
 - a support frame (251);
 - an electric motor (252) supported by the support frame (251) and provided with a drive shaft (253) rotatable about its own rotation central axis (A), wherein at a free end of the drive shaft an abrasive grindstone (255) is fixed; and
 - an electric actuator (257) configured to translate the abrasive grindstone (255) along a translation trajectory (D) that is parallel to its central axis (A) with respect to the support frame (251) between a backward position and an advanced position;
- the rectifying system (25) comprising, in addition,
- an abutment body (27) placed along the translation trajectory of the abrasive grindstone (255) at a predetermined distance from the support frame (251) and configured to contact an abrasive surface (2550) of the abrasive

grindstone (255) opposite the free end of the drive shaft (253); and

- an electronic control unit (30),

characterised in that

the electronic control unit (30) is configured for:

- activating the electric activator (257) to translate the abrasive grindstone (255) along the translation trajectory towards the advanced position;
- detecting a contact between the abrasive surface (2550) of the abrasive grindstone (250) and the abutment body (27) during the translation run of the abrasive grindstone (255) towards the advanced position, wherein the translation run is imposed to the abrasive grindstone (255) by the electric actuator (257); and
- determining a reference position of the abrasive surface (2550) of the abrasive grindstone (255) based on the detected contact.

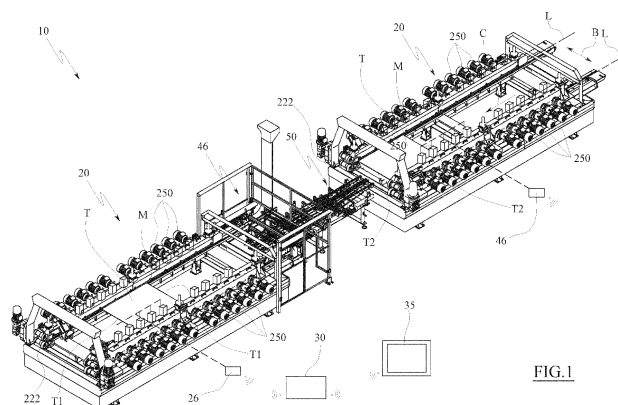


FIG. 1

DescriptionTECHNICAL FIELD

[0001] The present invention relates to the field of squaring machines, more in particular squaring machines for slabs or preferably, but not limited to, ceramic slabs, natural stone slabs, glass slabs or the like.

[0002] More in particular, the present invention relates to a rectifying system, a squaring machine provided with such rectifying system and a control method of the squaring machine.

PRIOR ART

[0003] As known slabs, such as ceramic slabs (paving or wall-covering tiles), natural stone slabs, glass slabs or the like, may require squaring operations suitable for making two opposite sides of the slab-shaped element that are substantially parallel and the adjacent sides substantially squared with the first ones.

[0004] Such operation is normally performed by squaring machines, which treat a plurality of slabs advancing in a sequence on a movement plane, for instance horizontal.

[0005] While advancing on the movement plane a surface of the slab-shaped elements runs into a sequence or rotating abrasive tools, which remove the exceeding material smoothing the surface.

[0006] The contact between the abrasive tools and the slab surface must occur in a proper way to perform an efficient surface treatment.

[0007] Therefore there exists a need for such squaring machines to systematically and periodically control that each of the abrasive tools performs an excellent treatment, i.e. contacts the surface of the slab to be treated properly, i.e. removes a proper amount of material from the slab being treated and that such control requires as little time as possible, since the time for equipping the squaring machine and positioning the abrasive tools in the correct working position is, as such, a downtime of the squaring machine.

[0008] An object of the present invention is to meet these and other needs, with a simple, efficient, systematic and rationale solution, as well as cheap and functional, simplifying and speeding up the presently existing control systems.

[0009] Such objects are achieved by the characteristics of the invention reported in the independent claims. The dependent claims outline preferred and/or particularly advantageous aspects of the invention.

DISCLOSURE OF THE INVENTION

[0010] The invention, in particular, makes available a rectifying system for slab squaring machines which comprises:

- a rectifying machine comprising:

- a support frame;
- an electric motor supported by the support frame and provided with a drive shaft rotatable about its own rotation central axis, wherein at a free end of the drive shaft an abrasive grindstone is fixed; and

an electric actuator configured to translate the abrasive grindstone along a translation trajectory that is parallel to its rotation central axis with respect to the support frame between a backward position and an advanced position;

- the rectifying system comprising, in addition, an abutment body placed along the translation trajectory of the abrasive grindstone at a predetermined distance from the support frame and configured to contact an abrasive surface of the abrasive grindstone opposite to the free end of the drive shaft; and
- an electronic control unit,

characterised in that

the electronic control unit is configured to:

- activate the electric actuator to translate the abrasive grindstone along the translation trajectory (from the backward position) towards the advanced position;
- detect a contact between the abrasive surface of the abrasive grindstone and the abutment body during the translation run of the abrasive grindstone towards the advanced position, wherein the translation run is imposed to the abrasive grindstone by the electric actuator; and
- determine a reference position of the abrasive surface of the abrasive grindstone based on the detected contact.

[0011] Thanks to this solution, it is possible to define the reference position and/or the working position of the abrasive grindstone each time compensating for the wear thereof, i.e. the natural backward movement of the abrasive surface thereof while being used, in a simple, functional and cheap way, making it possible to periodically reposition the abrasive grindstone in the proper working position.

[0012] Furthermore, when a squaring machine is equipped with a plurality of rectifying machines, it is possible to define the reference position and/or the working position of each abrasive grindstone of the squaring machine singularly and independently from the other ones, making it possible to equip and position, simultaneously, all the abrasive grindstones of the squaring machine saving a significant amount of time if compared to the known-type both manual and automatic squaring machines.

[0013] In particular, downtime due to positioning, correction thereof and equipment of the squaring machine is reduced even of about 80% if compared to the known

automatic squaring machines (from about 15 minutes for the known-type squaring machines to about 3 minutes for the squaring machine which is the object of the invention).

[0014] Moreover, it is possible to periodically define a control cycle, during which it can be defined, exactly and at any time in the life of the abrasive grindstone, the exact reference position of the abrasive surface (which is submitted to wear as it is used) of the abrasive grindstone, and, therefore, command - in the following use - that the (new) abrasive surface is positioned in a proper working position, thus compensating for the wear.

[0015] In practice, following each control cycle which can be performed any time a repositioning of the abrasive grindstone is required or periodically, the proper positioning of the abrasive surface (which moves as the abrasive grindstone undergoes wear) may be efficiently and quickly corrected up until it matches with the optimal pre-set working position, in which it meets the surface of the slab to be treated.

[0016] According to an advantageous aspect of the invention, in addition, the rectifying system may further comprise a sensor associated with the electric actuator and operatively connected to the electronic control unit, wherein the sensor is configured to detect a parameter indicating an electrical adsorption of the electric actuator.

[0017] For example, the parameter indicating the electrical adsorption of the electric actuator may be selected from the group consisting in a current adsorbed by the electric actuator and a torque adsorbed by the electric motor or both or another parameter related thereto.

[0018] Advantageously, the sensor may be placed on-board the electric actuator, for instance it may be integrated in a control board of the electric actuator.

[0019] However, it is not excluded that the sensor may be a remote sensor or in any way connected to the power supply line of the electric actuator, so as to read a parameter indicating the electrical adsorption of the electric actuator while starting the same.

[0020] According to a further aspect of the invention, then, in order to detect the contact between the abrasive surface of the abrasive grindstone and the abutment body, the electronic control unit may be configured to:

- continuously measure a value of a parameter indicating the electrical absorption of the electric actuator during the translation run (from the backward position) towards the advanced position;
- compare the measured value with a reference value thereof; and
- determine the contact occurred between the abrasive surface of the abrasive grindstone and the abutment body at the moment when the measured value becomes greater than or equal to the reference value.

[0021] Thanks to this, it is possible to easily and cost-effectively define with accuracy the position of the abra-

sive surface of the abrasive grindstone, for instance taking advantage of information (the electric adsorption of the electric actuator) which is always made available in commercial electric actuators (for example by a sensor already installed and existing to ensure the functioning thereof).

[0022] According to a simplified aspect of the invention, the reference value may be a pre-set value, for instance predefined during the calibration step (e.g. in an experimental step) and stored in a specific data storage unit from which the electronic control unit takes such information.

[0023] In alternative, according to an advantageous aspect of the invention, the electronic control unit may be further configured to:

- determine (repeatedly, e.g. at each control cycle) the reference value based on a plurality of measured values of the parameter indicating the electrical adsorption of the electric actuator during a predetermined tract of the translation run (from the backward position) towards the advanced position, wherein such translation run is shorter than a permitted maximum translation run.

[0024] For instance, the electronic control unit may be configured to determine such reference value as a value greater than one of the average value of the plurality of measured values of the parameter indicating the electrical adsorption or greater than the maximum value of the plurality of measured values of the parameter indicating the electrical adsorption (according to a predetermined algorithm selecting the predefined reference value and stored in a specific data storage unit from which the electronic control unit takes such information).

[0025] Preferably, the electric actuator may comprise an electric rotary motor provided with an (absolute) encoder, for instance such electric rotary motor may be configured to start rotating a rotatable mandrel, coaxial to the drive shaft, wherein the rotatable mandrel is in turn configured to start translating the abrasive grindstone along the translation trajectory following a rotation about a central axis (A) imposed to the rotatable mandrel by the electric motor.

[0026] Thanks to this, i.e. thanks to the encoder, the electric rotary motor can record the exact determined reference position and be commanded, with precision, (to perform a movement) to bring the abrasive surface (the reference position of which was exactly determined) to the desired working position.

[0027] According to an advantageous aspect of the present invention, the electronic control unit is operatively connected also to the electric motor and is configured to:

- de-activate the electric motor keeping the rotation of the abrasive grindstone fixed about the central axis during the translation run (from the backward position) towards the advanced position imposed by the

electric actuator.

[0028] Thanks to this, during the control cycle suitable for determining the aforesaid reference position, the abrasive grindstone, is stopped, so as not to damage or abrade the abutment body.

[0029] The reference body, as said, is placed along the translation trajectory of the abrasive grindstone, at the front of the abrasive surface, for instance in any convenient point, preferably but not limited to a position along the translation trajectory which is aligned on a plan (above or below) to the slab to be rectified (by such abrasive grindstone).

[0030] According to another aspect of the invention, the rectifying system can comprise a plurality of rectifying machines and one or more abutment bodies, preferably an abutment body for each rectifying machine, wherein each abutment body is placed along the translation trajectory of a respective abrasive grindstone at a respective predetermined distance from the support frame and is configured to contact the abrasive surface of the respective abrasive grindstone.

[0031] In such case, the rectifying system may provide a single electronic control unit suitable for all the rectifying machines or one electronic control unit for each rectifying machine of the plurality of rectifying machines, or also, a plurality of electronic control units each of which is suitable for a group of rectifying machines of the plurality of rectifying machines.

[0032] For example, the rectifying machines of the plurality of rectifying machines are adapted to be placed in sequence and insist one after the other on the same side of the slab to be rectified.

[0033] For the same above set-forth objects, a further aspect of the invention makes available a slab squaring machine which comprises:

- a conveyor supported by a base frame and provided with a movement plane on which slabs slide along an advancement direction;
- at least a rectifying system as above described, wherein the support frame of each rectifying machine is rigidly fixed to the base frame so that the translation trajectory imposed by the electric actuator to the abrasive grindstone is orthogonal to the advancement direction imposed to the slabs by the conveyor.

[0034] Still, a further aspect of the invention makes available a control method of a squaring machine, according to what above described, wherein the method provides to periodically perform, for each rectifying machine, a control cycle comprising the steps of:

- activating the electric actuator of each rectifying machine to translate the respective abrasive grindstone along the translation trajectory of a predetermined translation run (from the backward position) towards the advanced position;

- detecting a contact position between the abrasive surface of the abrasive grindstone and the respective abutment body during the translation run of the abrasive grindstone, (from the backward position) towards the advanced position, wherein the translation run is imposed to the abrasive grindstone by the electric actuator; and
- determining a reference position of the abrasive surface of the abrasive grindstone based on the detected contact position.

[0035] Still, the method can further comprise the step of:

- using the reference position determined for each abrasive grindstone to perform a rectifying process by means of the squaring machine.

[0036] The method, for example, can comprise, at the end of each control cycle, the steps of:

- determining a working position for each abrasive grindstone based on the determined reference position, wherein in the respective working position the abrasive surface of the respective abrasive grindstone is intended to contact a side of the slab to be rectified; and
- positioning each abrasive grindstone in the respective working position, activating the respective linear actuator.

[0037] In particular, once determined the reference position of the abrasive surface from such reference position it is possible to translate it to the optimal working position (by activating the linear actuator) and, therefore, activating the squaring machine to treat one or more slabs in sequence.

[0038] For example, the method may provide to: calculate a consumption value of the abrasive grindstone based on two reference positions determined in two separate control cycles.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] Further features and advantages of the invention will be more apparent after reading the following description provided by way of non-limiting example, with the aid of the accompanying drawings.

Figure 1 is an axonometric view of a plant according to the invention.

Figure 2 is a side view of figure 1.

Figure 3 is a view from above of figure 1.

Figure 4 is a view from above of a first squaring machine according to the invention.

Figure 5 is a view from above of a rotation assembly of the plant of figure 1.

Figure 6 is a view from above of a second squaring

machine according to the invention.

Figure 7 is a (schematic) side view of a rectifying system according to the invention.

Figure 8 is an operation diagram of a rectifying system and a squaring machine according to the invention.

BEST MODE OF THE INVENTION

[0040] Referring in particular to such figures, a plant for squaring slabs T, e.g. ceramic slabs, natural stone slabs, glass slabs or the like, is globally indicated by 10.

[0041] Each slab T has substantially a shape of a parallelepiped with a small height (thickness) and a substantially quadrangular base (on a plan), for instance rectangular or squared.

[0042] In practice, the slab T has two first opposite and substantially parallel sides T1 and two second sides T2 adjacent to the first sides T1 and mutually opposite and substantially parallel.

[0043] The plant 10 comprises a first squaring machine 20, for instance adapted to perform a rectifying and/or bevelling operation on the first two sides T1 of the slab T.

[0044] The first squaring machine 20 comprises a base frame 21 comprising a structure base 210 provided with common floor stands.

[0045] The base frame 21 comprises a pair of longitudinal parallel sidewalls 211 associated to the structure base 210 movably, in a mutually approaching and distancing direction, along a sliding direction B orthogonal to a longitudinal axis L thereof.

[0046] For example, between the structure base 210 and each of the sidewalls 211 a sliding guide (not visible) is defined that is adapted to keep the sidewalls 211 mutually parallel while mutually sliding along the sliding direction B.

[0047] Advantageously, the structure base 210 supports a translation assembly of the sidewalls 211, which can for instance comprise at least a motor fixed to the structure base 210 and motion transmitting means for example with toothed-wheels or belts, adapted to transfer the motion of a drive shaft of the motor to the sidewalls 211, to translate them along the sliding direction B.

[0048] For example, the translation assembly can comprise a motor for each sidewall 211, so that the translation of a sidewall 211 is substantially independent from the translation of the other one.

[0049] However, it must not be excluded that the translation assembly comprises only one motor and that, in alternative, the translation of the sidewalls is not automated.

[0050] Furthermore, the translation assembly can comprise synchronization means for the translation of the sidewalls 211, by which the sidewalls 211 are constrained in positions that are parallel and symmetrically opposite with respect to a sliding orthogonal median plane B.

[0051] The base frame 21 supports a movement as-

sembly 22 for moving the slabs T.

[0052] The movement assembly 22 is configured to move each slab T such that it lies (with the wide surfaces being visible and/or exposed) on a movement plane M, for instance substantially horizontal, and advances along an advancement direction C, for instance parallel to the longitudinal axis L of the sidewalls 211 and/or substantially parallel to the first sides T1 to be rectified.

[0053] The movement assembly 22, comprises for instance a conveyor 220, preferably a belt conveyor.

[0054] In particular, the movement assembly 22 comprises a pair of belt conveyors 220 each of which is supported by a respective sidewall 211.

[0055] Each belt conveyor 220 comprises a lower flexible member 221, which has an upper branch parallel to the advancement direction C and defines a portion of a mobile movement plane M for the slabs T.

[0056] The lower flexible members 221 of the belt conveyors 220, i.e. the respective upper branches, are substantially coplanar and, together, define the movement plane M (horizontal) for the slabs T.

[0057] For instance each lower flexible member 221 comprises or consists of a belt closed in a loop and wrapped on at least a driving pulley 222, rotated by a respective electric motor 223, and at least a driven pulley 224 (in the example a plurality of driven pulleys).

[0058] Each belt conveyor 220 also comprises an upper flexible member 225, which has a lower branch parallel to the advancement direction C and defines a mobile contact and pressure portion with the slabs T.

[0059] Each upper flexible member 225 is overlaid, for example overlaid on a plan and vertically aligned to the lower flexible member 221 of the belt conveyor 220 itself.

[0060] For example, each upper flexible member 225 may be associated to the respective sidewall 211 in a way that can be adjusted in height, so as to vary the size of the hollow space existing between the lower flexible member 221 and the upper flexible member 225, in particular between the upper branch of the lower flexible member 221 and the lower branch of the upper flexible member 225, based on the thickness of the slabs T.

[0061] The upper flexible members 225 of the pair of belt conveyors 220, i.e. the respective lower branches, together define a (horizontal) contact and pressure plane adapted to contact and press the upper surface (visible) of the slabs T.

[0062] For instance, each upper flexible member 225 comprises or consists of a belt closed in a loop and wrapped on at least one driving pulley 226, started rotating by a respective electric motor (for instance coincident with the electric motor 223), and at least a driven pulley (in the example a plurality of driven pulleys), not visible.

[0063] The electric motors 223 of both the belt conveyors 220 are driven in a synchronised way so as to enable the advancement of the slabs T along the advancement direction C with the first sides T1 parallel to the advancement direction C.

[0064] The lower flexible members 221, i.e. the upper

branches thereof, have a length that is greater than the respective upper flexible members 225, i.e. the lower branches thereof, such that an end of the lower flexible members 221, advantageously the upstream end in the advancement direction of the slabs T along the advancement direction C imposed by the movement assembly 22, is staggered with respect to the respective upper flexible member 225.

[0065] In practice, the staggered end of the lower flexible members 221 defines a tract of free entrance of the movement assembly 22 on which the slab T lies before being inserted between the lower flexible members 221 and the upper flexible members 225 and being tightly pressed between them.

[0066] The variation of the interaxis distance of the sidewalls 211 of the base frame 21 defines as such a corresponding variation of the interaxis distance of the belt conveyors 220, and consequently, the variation of the width of the lying plane defined by them depending on the size of the slabs T.

[0067] Furthermore, the interaxis distance of the sidewalls 211 is defined, from time to time depending on the size of the slabs T, in particular on the distance between the first sides T1 thereof, such that the first sides T1 of the slabs T protrude laterally (for a small tract), along a direction parallel to the sliding direction B, with respect to the movement plane M i.e. substantially cantilevered from it.

[0068] Advantageously, each belt conveyor 220 can comprise a pressor device (not shown), which is configured to push the upper branch of the lower flexible member 221 and the lower branch of the upper flexible member 225 in mutual approaching. For example the pressor device can comprise one or more support rods arranged inside the ring defined by each flexible member or by the only upper flexible member 225 that support a plurality of sliding blocks aligned and adjacent along the advancement direction C and pushed towards the other flexible member by compression springs.

[0069] Furthermore, the first squaring machine 20 comprises a centering assembly 23 configured to centre, with respect to a centering direction parallel to the sliding direction B, the slab T on the movement plane M, i.e. on the belt conveyor 220.

[0070] The centering assembly 23 comprises, for example, a pair of extending portions each of which is slidably associated to a respective sidewall 211 and which can be activated, e.g. by an electric actuator, moving close to and away from the movement plane M.

[0071] The first squaring machine 20 comprises, referring in particular to figure 7, a rectifying system 25 hereinafter described, which is configured to perform rectifying operations on the first sides T1 of the slab T.

[0072] The rectifying system 25 comprises at least a rectifying machine 250, for example at least a rectifying machine 250 configured to treat a surface of the slab T moving along the advancement direction C, i.e. one of the first sides T1 thereof.

[0073] In practice, the rectifying machine 250 is placed on the side of the movement plane M, for example supported by a sidewall 211 of the base frame 21.

[0074] In particular, the first squaring machine 20 comprises at least a rectifying machine 250 for each first side T1 of the slab T to be treated, i.e. placed at the sides of the movement plane M, for instance each one supported by a respective sidewall 211 of the base frame 21.

[0075] Each rectifying machine 250 comprises a rigid support frame 251 (i.e. not deformable when submitted to the usual loads it is intended for), preferably made of metal.

[0076] The support frame 251 of each rectifying machine 250 is rigidly fixed (e.g. bolted) to the base frame 21, i.e. preferably to a respective sidewall 211.

[0077] Each rectifying machine 10 also comprises an electric motor 252 supported by the support frame 251 (e.g. at the rear thereof, that is at the opposite side with respect to the longitudinal vertical median plane of the belt conveyor 220) and provided with a drive shaft 253 rotatable about a central axis A thereof.

[0078] Each rectifying machine 250 is arranged with its central axis A substantially horizontal i.e. parallel to the movement plane M and orthogonal to the advancement direction C.

[0079] The support frame 251 is defined for instance by a U-shaped element provided with a central hole (coaxial with the central axis A) in which it is fitted (with a clearance) a front portion of the drive shaft 253 which protrudes at the front (i.e. towards the longitudinal vertical median plane of the conveyor belt 220) with respect to the support frame 251.

[0080] The electric motor 252, as known, is provided with a stator integral with an external crankcase and a rotor integral with the drive shaft 253 and preferably coaxial thereto.

[0081] The drive shaft 253 of each rectifying machine 250 is provided with:

- a free (front) end, which for instance projects axially at the front of the support frame 251, which an abrasive grindstone 255 is rigidly fixed to, directly or indirectly, (without residual degrees of freedom, despite being removable), and
- an opposite (rear) end which, preferably, remains axially contained inside the crankcase of the electric motor 252.

[0082] The abrasive grindstone 255 is defined by a disc-shaped/annular body (coaxial to the central axis A) which comprises an attachment surface, facing the electric motor 252, which is fixed (removably) to the free end of the drive shaft 252, for example at an attachment flange provided therein, and an opposite free abrasive surface 2550.

[0083] The abrasive surface 2550 represents the abrasive front face of the abrasive grindstone 255, i.e. the front end (i.e. facing the longitudinal vertical median

plane of the belt conveyor 220) of the abrasive grindstone 255 (and of the entire rectifying machine 250).

[0084] For example, the abrasive grindstone 255 moves close to and/or away from the movement plane M, i.e. it can be translated along a (rectilinear) translation trajectory D that is parallel to (and coincident with) the sliding direction B i.e. the central axis A.

[0085] In detail, each rectifying machine 250 comprises an actuating assembly configured to translate the abrasive grindstone 255 (i.e. the front portion of the drive shaft 253 supporting it) along the translation trajectory D parallel to (and coincident with) the central axis A of the drive shaft 253, as will be better described hereinafter.

[0086] In the preferred illustrated example, the actuation assembly comprises a mandrel 256 rotatable about a central axis A, for instance substantially cylindrical, which is coupled to a front portion of the drive shaft 253 (comprising the free end thereof which the abrasive grindstone 255 is associated to).

[0087] Between the mandrel 256 and the front portion of the drive shaft 253 motion transforming means (known in the sector) are interposed, for instance of the threaded type, configured to transform the rotatable motion around the central axis A of the mandrel 256 into a translation motion along the translation trajectory D of the front portion of the drive shaft 253 (i.e. of the abrasive grindstone 255).

[0088] The actuation unit comprises an electric actuator 257, which is configured to actuate in translation the front portion of the drive shaft 253, i.e. the abrasive grindstone 255, preferably in the two translation directions, along the translation trajectory D.

[0089] In the example the electric actuator 257 comprises (or consists of) an electric motor, for example a brushless motor, provided with an encoder 258 (configured to control the number of revolutions of the brushless motor and, consequently, the point-to-point movement of the abrasive grindstone 255 along the translation trajectory).

[0090] The drive shaft of the electric actuator 257 is connected to the mandrel 256, for example by means of motion transmitting members, such as a belt/chain connection with pulleys/ring gears or a gearwheel mechanism or the like (such to transfer the drive shaft rotation of the electric actuator 257 to the mandrel 256 and, therefore, start the translation of the abrasive grindstone 255).

[0091] The electric actuator 257 (i.e. its crankcase supporting the stator) is supported by the support frame 251, for example it is rigidly fixed to the crankcase of the electric motor 252.

[0092] In the crankcase of the electric actuator 257 they are housed (at least a portion of) the power supply wires, for instance connectable externally by suitable connectors, and a control board of the electric actuator 257.

[0093] The rectifying system 25, i.e. each rectifying machine 250, comprises a sensor 26 (i.e. a transducer), which is configured to detect a parameter indicating the

electrical adsorption of the electric actuator 257, i.e. of the brushless motor thereof.

[0094] For example, the parameter indicating the electrical adsorption is selected from the group consisting in a current adsorbed by the electric actuator 257 (during the operation thereof) and a torque adsorbed by the electric motor (during the operation thereof) or both or another parameter related thereto.

[0095] In particular, the sensor 26 is connected to one or more power supply wires which supply the electric actuator 257, such to detect and measure the parameter indicating the voltage or current electrical adsorption (i.e. amperage and/or consumption).

[0096] Particularly, the sensor 26 is placed on-board the electric actuator 257, i.e. the crankcase thereof, it must not be excluded that it is placed remote, for instance at any point of the supply line of the electric actuator 257.

[0097] The linear actuator 257 of each rectifying machine 250 is configured to start (translating along the translation trajectory D) the respective abrasive grindstone 255 between a backward position, for example wherein it (i.e. its abrasive surface 2550) is placed distal from the first side T1 of the slab T to be treated and supported by the movement plane M (for example defined by a rear - physical - end-stop placed at a predetermined axial position along the translation trajectory D of the abrasive grindstone 255), and an advanced position, for instance wherein it (i.e. its abrasive surface 2550) is placed closer (it is in the closest allowed position) to the longitudinal vertical median plane of the conveyor 220.

[0098] While being used, the abrasive grindstone 255 of each rectifying machine 250, i.e. its abrasive surface 2550, is adapted to be placed at a predetermined working position, wherein the abrasive surface 2550 of the abrasive grindstone 255 is intended to contact the first side T1 to be rectified of the slab T.

[0099] The working position is interposed between the backward position and the advanced position, as will be better described hereinafter.

[0100] The rectifying system 25 further comprises in particular an abutment body 27, which is configured to define a mechanic end-stop for the abrasive grindstone 250 of one (each) rectifying machine 250 or a plurality of rectifying machines 250.

[0101] In detail, the abutment body 27 is configured to (physically) contact the abrasive surface 2550 of the abrasive grindstone of one (each) rectifying machine 250 or a plurality of rectifying machines 250.

[0102] In practice, the abutment body 27 is placed along the translation trajectory D of the abrasive grindstone 255 at a predetermined distance (fixed or adjustable or in any case predetermined) from the support frame 251 (i.e. from any predetermined point thereof) of the rectifying machine 250.

[0103] For example, the abutment body 27 defines the advanced position (of maximum possible advancement) of the (respective) abrasive grindstone 255 along its translation trajectory D.

[0104] The abutment body 27 is, for example, directly or indirectly, integral with the support frame 252 of the rectifying machine 250.

[0105] The abutment body 27 comprises for example a (rigid) buffer associated (rigidly fixed) for example to the base frame 21, for example to the sidewall 211 supporting the respective support frame 251.

[0106] In alternative, the abutment body 27 may be defined by a part of the base frame 21, for example of the sidewall 211 supporting the respective support frame 251, i.e. for example a portion of the underbelt or other rigid structural part that defines the sidewall 211.

[0107] In one alternative embodiment, the abutment body 27 may be a switch, for example a micro switch associated (rigidly fixed) for example with the base frame 21, for example with the sidewall 211 that supports the respective support frame 251.

[0108] The abutment body 27 is integral with the sidewall 211 (and with the support frame 251) in the mutual sliding of the sidewalls 211 performed by the translation assembly of the sidewalls 211.

[0109] Still, in another possible embodiment, the abutment body 27 may be defined by a first sidewall of a reference slab, with sizes that are known and taken as a reference, placed on the conveyor 220.

[0110] In the example, the rectifying system 25 provides a plurality of abutment bodies 27 (equal in number to the rectifying machines 25), in which each abutment body 27 is associated with one (single) respective rectifying machine 250.

[0111] For example, the various abutment bodies 27 are placed at the same predetermined distance from the support frame 251 of the rectifying machine 250.

[0112] It must not be excluded that the various abutment bodies 27 can be placed at a respective predetermined distance from the support frame 251 of the rectifying machine 250, differing one from the other or can be variously decided at the assembling step.

[0113] In alternative to what above described, it is also possible to provide that the rectifying system 25 has an abutment body 27 associated to more than one rectifying machine 250, i.e. in common with more rectifying machines 250 (i.e. intended to contact, simultaneously or selectively, the abrasive surface 2550 of more abrasive grindstones 255).

[0114] The first squaring machine 20, in this specific case, comprises a plurality of rectifying machines 250 for each (opposite) first side T1 of the slab T to be rectified.

[0115] In practice, the first squaring machine 20 comprises a plurality of rectifying machines 250 on the right of the longitudinal vertical median plane of the conveyor 220 and a plurality of rectifying machines 250 on the left of the longitudinal vertical median plane of the conveyor 220.

[0116] For example, each rectifying machine 250 of one of the sidewalls 211 is substantially symmetrical with respect to the longitudinal vertical median plane of the conveyor 220 (orthogonal to the sliding direction B) to a

rectifying machine 250 of the other sidewall 211.

[0117] The rectifying machines 250 are arranged with the rotation axis horizontal and orthogonal to the advancement direction C.

[0118] In other words, the drive shaft (and therefore the abrasive grindstone 255) of each rectifying machine 250 is started rotating about its own central axis A which is substantially horizontal and orthogonal to the advancement direction C.

[0119] Each sidewall 211 can further support a beveling machine (at all equal or similar to any one of the rectifying machines 250), which is placed downstream in the advancement direction of the slabs T along the advancement direction C imposed by the movement assembly 22, and it is configured to perform a bevel on the respective first side T1 of the slab T.

[0120] Such bevelling machine is arranged with a rotation axis lying on a plane that is tilted with respect to the horizontal plane and in any case orthogonal to the advancement direction C.

[0121] The first squaring machine 20 is for instance a dry squaring machine, i.e. the contact between the abrasive grindstone 255 and the surface of the slab T occurs in a dry environment, i.e. without a coolant and/or a lubricant of the mutual contact/working zone.

[0122] The first squaring machine 20 can further comprise an optical assembly placed at each abrasive grindstone 255, preferably at the contact zone of the respective abrasive grindstone 255 with the respective first side T1 of the slab T, to assist the control of the first squaring machine 20.

[0123] The plant 10 and/or the first squaring machine 20 and/or the rectifying system 25 comprises an electronic control unit 30, for instance provided with a data storage unit and a computer.

[0124] The plant 10 and/or the first squaring machine 20 and/or the rectifying system 25 may comprise a, signalling, user interface 35, which is operatively connected (for instance wirelessly) to the electronic control unit 30 to output one or more signals, for example of the visible and/or acoustic type, which can be perceived by a user when the electronic control unit 30 generates an error signal.

[0125] For example, the user interface 35 may be defined by a PC with a screen and, for example, be fixed to the base frame 21 of the first squaring machine 20 or positioned remote or be a mobile device.

[0126] The electronic control unit 30 is configured to manage and control the operability of the first squaring machine 20 and/or of the rectifying system 25 and/or of one, an assembly or each of the rectifying machines 250, as will be better described.

[0127] The electronic control unit 30 can be operatively connected to the electric motor 252 (of each rectifying machine 250) to command the activation and de-activation thereof, activating and de-activating the rotation of the related abrasive grindstone 255.

[0128] The electronic control unit 30 can be operatively

connected to the electric actuator 257 (of each rectifying machine 250) to command the activation and de-activation thereof (immediate, i.e. in 1 millisecond from the command).

[0129] In practice, the electronic control unit 30 is configured, for instance by activating the electric activator 257, to move the respective abrasive grindstone 255, along the translation trajectory D, alternatively between the backward position and the advanced position and to position the respective abrasive grindstone 255 in its working position.

[0130] For example, the electronic control unit 30 may be further operatively connected to the encoder 258 of the electric actuator 257 and configured to monitor the displacement of the abrasive grindstone 255 along its translation trajectory, so as to block the movement thereof (by means of an immediate deactivation) when the abrasive grindstone 255 has reached a desired position, for example the predetermined desired position.

[0131] Still, the electronic control unit 30 can be operatively connected to the sensor 26, so as to receive (continuously during the activation of the electric actuator 257) a signal indicating the measure of the parameter indicating the electrical adsorption of the electric actuator 257, for instance while using it, i.e. during the translation imposed from it to the abrasive grindstone 255, along its translation trajectory.

[0132] Particularly, the electronic control unit 30 is configured to perform, for example periodically or any time it is deemed as necessary a repositioning of the single abrasive grindstone 255 (after wear thereof) or of a plurality of them, a control cycle (and repositioning) as hereinafter described.

[0133] For example, the electronic control unit 30 can perform the control cycle (hereinafter described referring to only one rectifying machine 25) on each of the rectifying machines 25, for example simultaneously or in sequence or when desired.

[0134] The control cycle is for instance performed when there are no slabs T to be treated on the conveyor 220.

[0135] The control cycle, referring in particular to figure 8, preferably provides to de-activate (block S1) the electric motor 252 (so as to stop the rotation of the abrasive grindstone 255).

[0136] Thereafter, for example from the retracted position or from any predefined starting position, the electronic control unit 30 is configured to activate (block S2) the electric actuator 257 in order to operate the translation of the abrasive grindstone 255 towards the advanced position.

[0137] The electronic control unit 30 is thus configured to detect (block S3) the contact occurred between the abrasive surface 2550 of the abrasive grindstone 250 and its abutment body 27 during the translation run of the abrasive grindstone 250, towards the advanced position.

[0138] In the preferred embodiment, in order to detect

the contact occurred between the abrasive surface 2550 of the abrasive grindstone 250, the electronic control unit is configured to continuously measure (block S3.1), by the sensor 26, the value of the parameter indicating the electrical adsorption of the electric actuator 257 during the translation run (from the backward position or from said starting position) towards the advanced position.

[0139] Furthermore, during such translation run towards the advanced position, the electronic control unit 30 is configured to compare (block S3.3) the value measured with a reference value thereof.

[0140] In one simplified embodiment, the reference value can be a pre-set value, for example predefined during the calibration step (for example in an experimental step) and stored in the data storage unit of the electronic control unit 30 from which it is taken to make it available at the block S3.3.

[0141] In one preferred alternative embodiment, by contrast, the electronic control unit can be further configured to determine (block S3.2), for example repeatedly, e.g. at each control cycle, the reference value based on a plurality of measured values of the parameter indicating the electrical adsorption of the electric actuator 257 during a predetermined tract of the translation run from the backward position to the advanced position, wherein such translation run is shorter than a maximum permitted translation run.

[0142] In practice, the reference value is assessed based on a plurality of measured values, for example is greater than the average value of the measures or is equal to or greater than the maximum value detected in a determined tract of distal translation run from the advanced position.

[0143] The reference value is, in any case, a value indicating that the electric actuator 257 has a high electrical adsorption caused by a high resistance to the advancing movement of the abrasive grindstone 255 due to an external restraining action, i.e. a fixed obstacle (defined by the abutment body 27) on the translation trajectory.

[0144] In other words, the reference value is a value indicating an electrical adsorption greater than zero and greater than the electrical adsorption required to start translating the abrasive grindstone 255 (free) along its translation trajectory.

[0145] In practice, when the measured value is equal to or overcomes the reference value, it is certain that the abrasive grindstone 250, i.e. its abrasive surface 2550 is in contact with the abutment body 27.

[0146] Therefore, the electronic control unit 30 is configured to determine (block S3.4) the contact occurred between the abrasive surface 2550 of the abrasive grindstone 255 and the abutment body 27 at the moment when the measured value become greater than or equal to the aforesaid reference value.

[0147] In practice, in order to do so, the electronic control unit is configured to command (block S3.4.1) the immediate de-activation of the electric actuator 257, i.e. interrupt immediately the translation of the abrasive grind-

stone 255 (leaving the abrasive surface 2550 stopped in contact with the abutment body 27), at the moment when the measured value becomes greater than or equal to the aforesaid reference value.

[0148] With the abrasive grindstone 255 thus stopped (its abrasive surface 2550 in contact with the abutment body 27), the electronic control unit 30 is configured to determine (block S3.5) an (absolute) reference position taken by the abrasive surface 2550 of the abrasive grindstone 25.

[0149] In particular, the electronic control unit 30 is configured to detect, by the encoder 258, the (absolute) position reached by the abrasive grindstone 255 when its abrasive surface 2550 is put in contact with the abutment body 27 and, to set such position as a new reference (or zero) position for such rectifying machine 250.

[0150] In practice, the electronic control unit 30 is able to determine (as the abrasive grindstone 255 undergoes wear, i.e. the abrasive surface 2550 goes backward towards the attachment surface) the real position of the abrasive surface (i.e. the relative position with respect to the attachment surface) defining it as (new) reference position.

[0151] For example, the plant 10 can then comprise a second squaring machine 20, placed downstream of the first squaring machine 20 in the advancement direction of the slabs T, which is for example adapted to perform a rectifying and/or bevelling operation on the two second sides T2 of the slab T (orthogonal to first sides T1).

[0152] The second squaring machine 20 placed downstream is at all similar, if not identical, to the first squaring machine 20 placed upstream, thus, for the sake of brevity, the structure will not be described again, but reference is made to the above mentioned description of the first squaring machine 20 with the only difference that the sides treated by this second squaring machine 20 are the second sides T2 of the slab T.

[0153] The second squaring machine 20 is operatively connected, as the first squaring machine 20, to the same above described electronic control unit 30 or to a respective equally programmed electronic control unit 30.

[0154] Between the first and the second squaring machine 20, for instance immediately upstream of the second squaring machine 20 in the advancement direction of the slabs T along the advancement direction C thereof, a pusher assembly 46 is associated, which is configured to carry out a rear pushing action on the slab T entering the second squaring machine 20, for example in simultaneous actuation with the centering assembly 23 in order to position the slab T as squared.

[0155] For example the pusher assembly 46 is adapted to position the slab T on the movement plane M of the second squaring machine 20 so as to compensate for possible errors encountered in the difference between the diagonal lines of the same piece exiting from the first squaring machine 20.

[0156] The pusher assembly 46 comprises one first pusher 461 and one second pusher 462, which are al-

ternatively, and independently, mobile, along the advancement direction C and are adapted to contact and push (ad a speed greater than the advancement speed of the slabs T on the movement plane) the rear first side T1 in the advancement direction of the slab T along the advancement direction C of the slab T entering the second squaring machine 20.

[0157] In practice, the first pusher 461 and the second pusher 462, i.e. their surface contacting the first side T1, define a pushing plane that can be tilted (according to the staggering of the first pusher 461 with respect to the second pusher 462 in the advancement direction C) with respect to a plane orthogonal to the advancement direction of the slab T for adjusting the inclination of the rear side with respect to the plane orthogonal to the advancement direction.

[0158] In particular the pusher assembly 46 comprises a first actuator 463 associated to the first pusher 461 and configured to translate the first pusher 461, along the advancement direction C, and a second actuator 464 associated to the second pusher 462, for example independent from the first pusher 461, and configured to translate the second pusher 462, along the advancement direction C.

[0159] Advantageously, the pusher assembly 46 and in particular the first actuator 463 and the second actuator 464, are operatively connected to one control unit, which is configured to command the first pusher 461 and the second pusher 462 to advance for mutually positioning and translating along the advancement direction C (in synchrony with the activation of the centering assembly 23).

[0160] Between the first squaring machine 20 and the second squaring machine 20, for example upstream of the pusher assembly 46 in the advancement direction of the slabs T provided by the movement planes M of the respective squaring machines 20, the plant 10 can comprise a rotation assembly 50, also called tile turner, adapted to rotate the slab T, for instance of 90° with respect to a vertical rotation axis (orthogonal to the movement plane M), such that the second sides T2 are arranged substantially parallel to the advancement direction C of the second squaring machine 20 along the movement plane M.

[0161] The rotation assembly 50 comprises, for example, a pair of belts 51 closed in a ring and wrapped respectively on a driving pulley, connected to a respective driving motor 52 and a driven pulley.

[0162] The upper branch of the belts 51 defines a plane for bearing and moving the slab T, for moving the slab T along an advancement direction C, which can be coincident with the advancement direction C imposed by the movement plane M (of the first squaring machine 20 and/or of the second squaring machine 20).

[0163] The driving motors 52 of each belt 51 can be mutually operated independently.

[0164] In particular, the mutual rotation speed of the two driving motors 52 may vary between a first configu-

ration, wherein the two driving motors 52 are synchronous, i.e. they rotate the respective driving pulley at the same speed, and a second configuration wherein the two driving motors are asynchronous, i.e. they rotate the respective driving pulley at different speeds (for example also one into a rotation direction and the other one into another rotation direction).

[0165] By actuating the driving motors 52 in the second configuration, for a small period that can be set up when the slab T is lying on the belts 51, the slab T is rotated by 90° remaining substantially horizontal and bringing the second sides T2 parallel to the advancement direction C, such to be fed to the second squaring machine 20 in order to rectify the second sides T2.

[0166] In light of the above, the operation of the plant 10 is as follows.

[0167] The sidewalls 211 of the first squaring machine 20 are placed at a mutual distance so as to define a movement plane M adapted to support, as described above, the slabs T with the first parallel sides T1 parallel to the advancement direction C.

[0168] The slabs T are arranged as lying on the movement plane M of the first squaring machine 20 with a surface thereof (lower or not visible) which is in contact with the movement plane M and an opposite surface (upper or visible) to be treated facing upwards.

[0169] Once a slab T lies on the upstream end, in the advancement direction of the slabs T along the advancement direction C imposed by the movement assembly 22, of the lower flexible members 221 of the first squaring machine 20, it is centered by the centering assembly 23, and once centered, it is inserted between the lower flexible members 221 and the upper flexible members 225, and once restrained, it is conveyed by them along the advancement direction C.

[0170] As the slabs T advance along the advancement direction C on the movement plane M of the first squaring machine 20, the first sides T1 are intercepted by the abrasive surface 2550 of the abrasive grindstones 255 positioned in their predefined working position, which level and rectify the surface and/or bevel it along a predefined removal cone.

[0171] The electronic control unit 30 is periodically configured to perform the aforesaid control cycle, so as to enable the proper positioning of the abrasive grindstones 255 as they wear out.

[0172] The slabs T exiting from the first squaring machine 20 advancing along the advancement direction C are rotated by the rotation assembly 50 and, once centered by the centering assembly 23 of the second squaring machine and pushed by the pusher assembly 46, are inserted between the lower flexible members 221 and the upper flexible members 225 of the movement assembly 22 of the second squaring machine to be conveyed along the advancement direction C.

[0173] As the slabs T advance along the advancement direction C on the movement plane of the second squaring machine 20 the second sides T2 are intercepted by

the abrasive grindstones 255 thereof which level and rectify the surface and/or bevel it according to a predefined removal cone.

[0174] Thanks to the above described solution it is possible to equip each squaring machine in a way that is simple, quick and automated and independent from the skilled personnel in charge of the rectifying operation.

[0175] Thanks to the above described solution it is also possible to have a system for controlling and recovering the single abrasive tool and repositioning the worn-out abrasive tool in the proper working position.

[0176] The invention thus conceived is susceptible to several modifications and variations, all falling within the scope of the inventive concept.

[0177] Moreover, all the details can be replaced by other technically equivalent elements.

[0178] In practice, the materials used, as well as the contingent shapes and sizes, can be whatever according to the requirements without for this reason departing from the scope of protection of the following claims.

Claims

1. A rectifying system (25) for slab squaring machines which comprises:

- a rectifying machine (250) comprising:

- a support frame (251);
- an electric motor (252) supported by the support frame (251) and provided with a drive shaft (253) rotatable about its own rotation central axis (A), wherein at a free end of the drive shaft an abrasive grindstone (255) is fixed; and
- an electric actuator (257) configured to translate the abrasive grindstone (255) along a translation trajectory (D) that is parallel to its central axis (A) with respect to the support frame (251) between a backward position and an advanced position;

the rectifying system (25) comprising, in addition,

- an abutment body (27) placed along the translation trajectory of the abrasive grindstone (255) at a predetermined distance from the support frame (251) and configured to contact an abrasive surface (2550) of the abrasive grindstone (255) opposite the free end of the drive shaft (253); and
- an electronic control unit (30),

characterised in that

the electronic control unit (30) is configured to perform a control cycle that comprises:

- activating the electric activator (257) to translate the abrasive grindstone (255) along the translation trajectory towards the advanced position;
 - detecting a contact between the abrasive surface (2550) of the abrasive grindstone (250) and the abutment body (27) during the translation run of the abrasive grindstone (255) towards the advanced position, wherein the translation run is imposed to the abrasive grindstone (255) by the electric actuator (257); and
 - determining a reference position of the abrasive surface (2550) of the abrasive grindstone (255) based on the detected contact.
2. The rectifying system (25) according to claims 1, which further comprises a sensor (26) associated with the electric actuator (257) and operatively connected to the electronic control unit (30), wherein the sensor (26) is configured to detect a parameter indicating an electrical absorption or the electric actuator (257).
3. The rectifying system (25) according to claim 2, wherein in order to detect the contact between the abrasive surface (2550) of the abrasive grindstone (255) and the abutment body (27), the electronic control unit (30) is configured to:
- continuously measure a value of a parameter indicating the electrical absorption of the electric actuator (257) during the translation run towards the advanced position;
 - compare the measured value with a reference value thereof; and
 - determine the contact occurred between the abrasive surface (2550) of the abrasive grindstone (255) and the abutment body (27) at the moment when the measured value becomes greater than or equal to the reference value.
4. The rectifying system (25) according to claim 3, wherein the electronic control unit (30) is further configured to:
- determine the reference value based on a plurality of measured values of the parameter indicating the electrical absorption of the electric actuator (257) during a predetermined tract of the translation run towards the advanced position, wherein such a translation run is shorter than a maximum permitted translation run.
5. The rectifying system (25) according to claim 2, wherein the sensor (26) is placed on board the electric actuator (257).
6. The rectifying system (25) according to claim 1,
- wherein the electric actuator (257) comprises an electric rotatable motor provided with an encoder (258) and configured to start rotating a rotatable mandrel (256), coaxial to the drive shaft (253), wherein the rotatable mandrel (256) is in turn configured to start translating the abrasive grindstone (255) along the translation trajectory (D) following a rotation about a central axis (A) imposed to the rotatable mandrel (256) by the electric rotatable motor of the electric actuator (257).
7. The rectifying system (25) according to claim 1, wherein the electronic control unit (30) is also operatively connected to the electric motor (252) and is configured to:
- deactivate the electric motor (252) keeping stopped the abrasive grindstone rotation (255) about the central axis (A) during the translation run towards the advanced position imposed by the electric actuator (257).
8. The rectifying system (25) according to claim 1, which comprises a plurality of rectifying machines (250) and one or more abutment bodies (27), preferably an abutment body (27) for each rectifying machine (250), wherein each abutment body (27) is placed along the translation trajectory (D) of a respective abrasive grindstone (255) at a respective predetermined distance from the support frame (251) and is configured to contact the abrasive surface (2550) of the respective abrasive grindstone (255).
9. A squaring machine (20) for slabs (T) that comprises:
- a conveyor (220) supported by a base frame (21) and provided with a movement plane (M) on which slabs (T) slide along an advancement direction (C);
 - at least a rectifying system (25) according to the preceding claim, wherein the support frame (251) of each rectifying machine (250) is rigidly fixed to the base frame (21) such that the translation trajectory (D) imposed by the electric actuator (257) to the abrasive grindstone (255) is orthogonal to the advancement direction (C) imposed to the slabs (T) by the conveyor (220).
10. A control method of a squaring machine (20), according to the preceding claim, wherein the method provides to periodically perform, for each rectifying machine (250), a control cycle comprising the steps of:
- activating the electric actuator (257) of each rectifying machine (250) to translate the respective abrasive grindstone (255) along the trans-

lation trajectory (D) of a predetermined translation run towards the advanced position;

- detecting a contact position between the abrasive surface (2550) of the abrasive grindstone (255) and the respective abutment body (27) during the translation run of the abrasive grindstone (255), towards the advanced position, wherein the translation run is imposed to the abrasive grindstone (255) by the electric actuator (257); and
- determining a reference position of the abrasive surface (2550) of the abrasive grindstone (255) based on the detected contact position.

11. The method according to the preceding claim, which further comprises the step of:

- using the reference position determined for each abrasive grindstone (255) to perform a rectifying process by means of the squaring machine (20).

12. The method according to claim 10, which comprises, after each control cycle, the steps of:

- determining a working position for each abrasive grindstone (255) based on the determined reference position, wherein in the respective working position the abrasive surface (2550) of the respective abrasive grindstone (255) is intended to contact a side of the slab (T) to be rectified; and
- positioning each abrasive grindstone (255) in the respective working position, activating the respective electric actuator (257).

13. The method according to claim 10, which further comprises the step of:

- calculating a consumption value of the abrasive grindstone (255) based on two reference positions determined in two separate control cycles.

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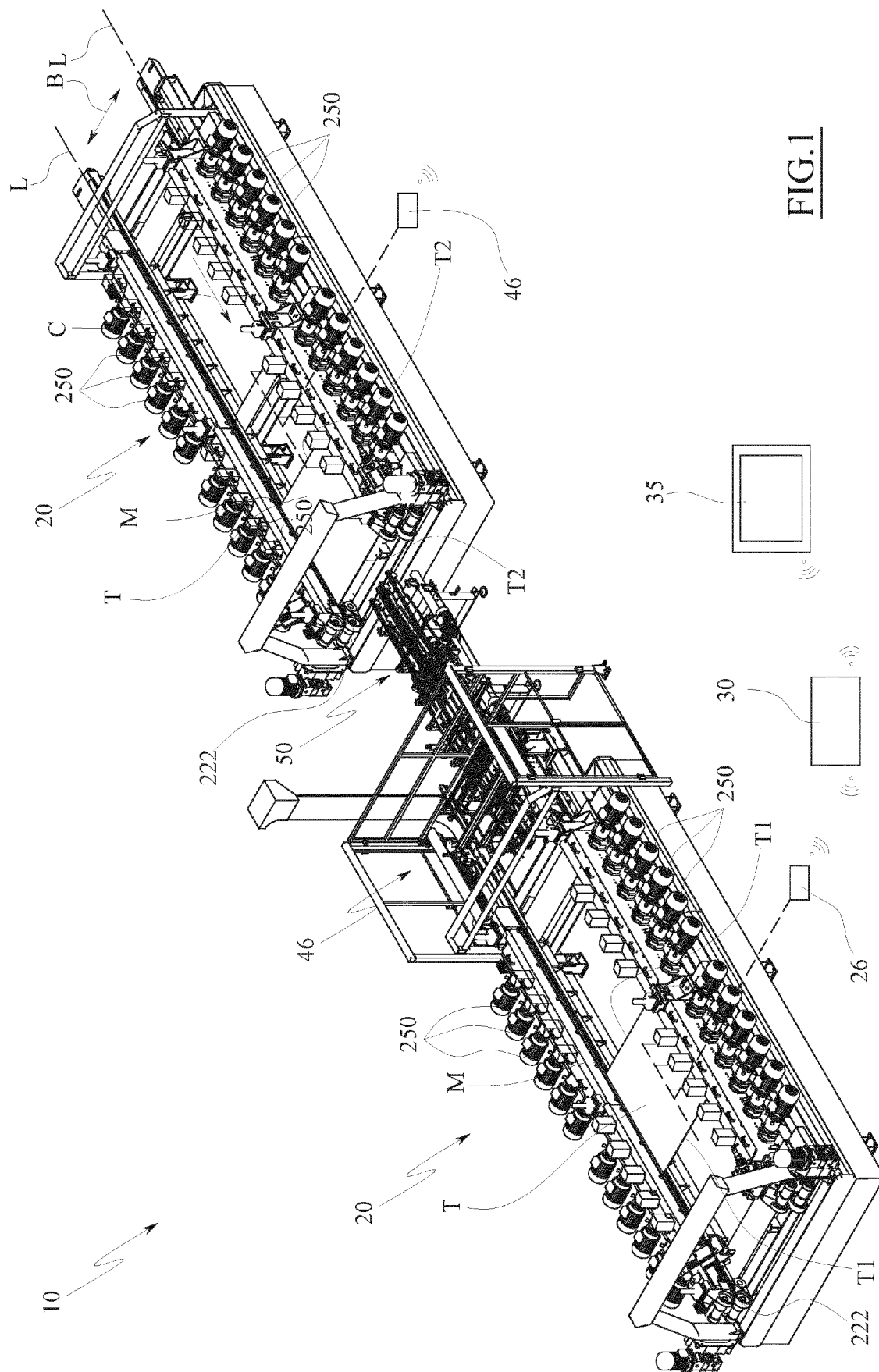
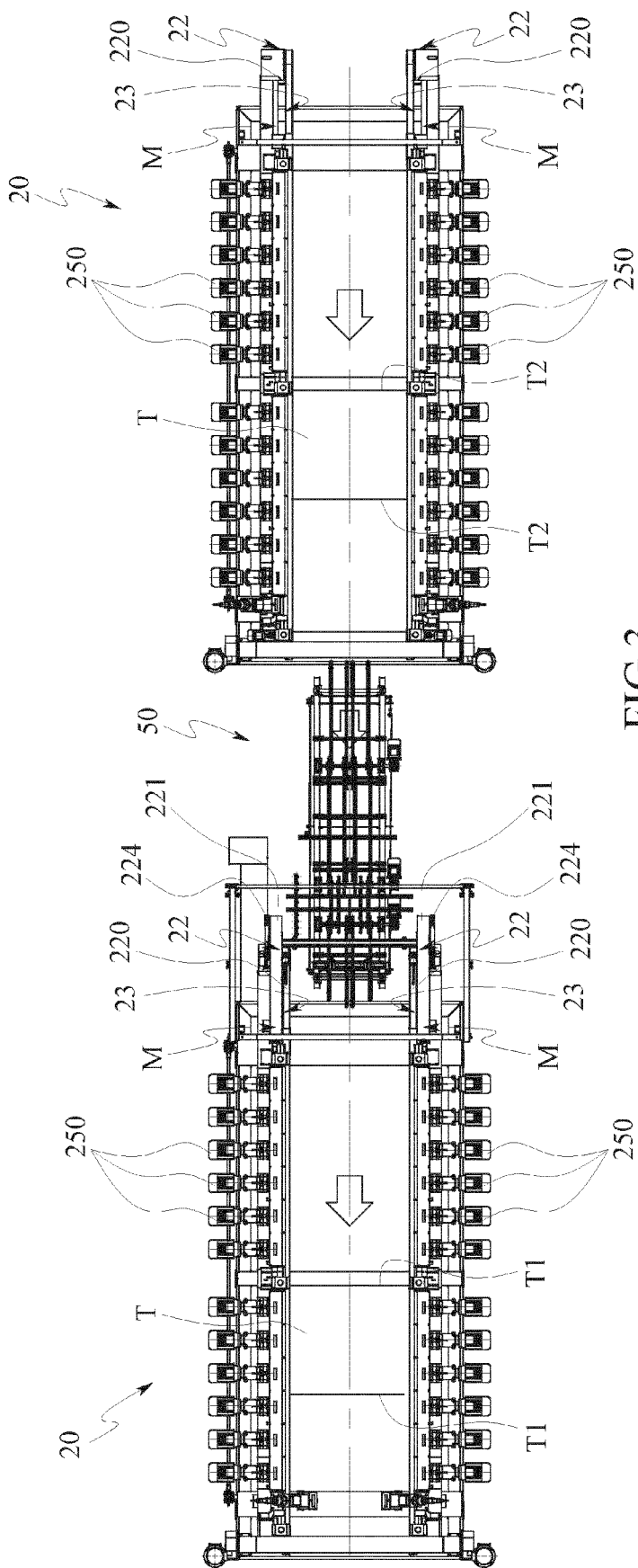
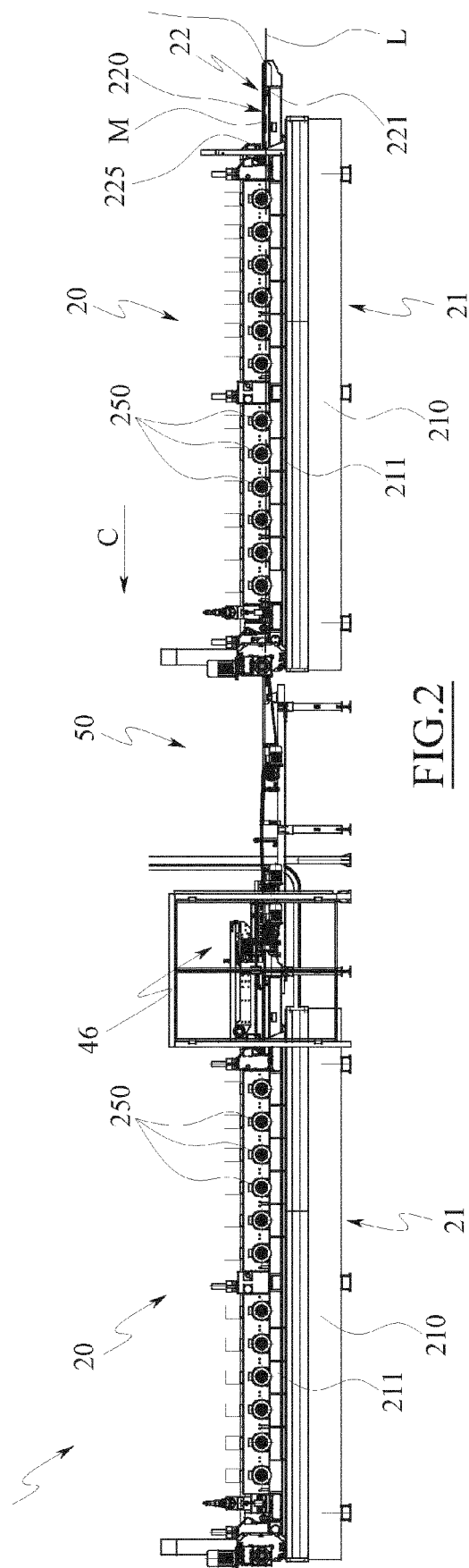


FIG. 1



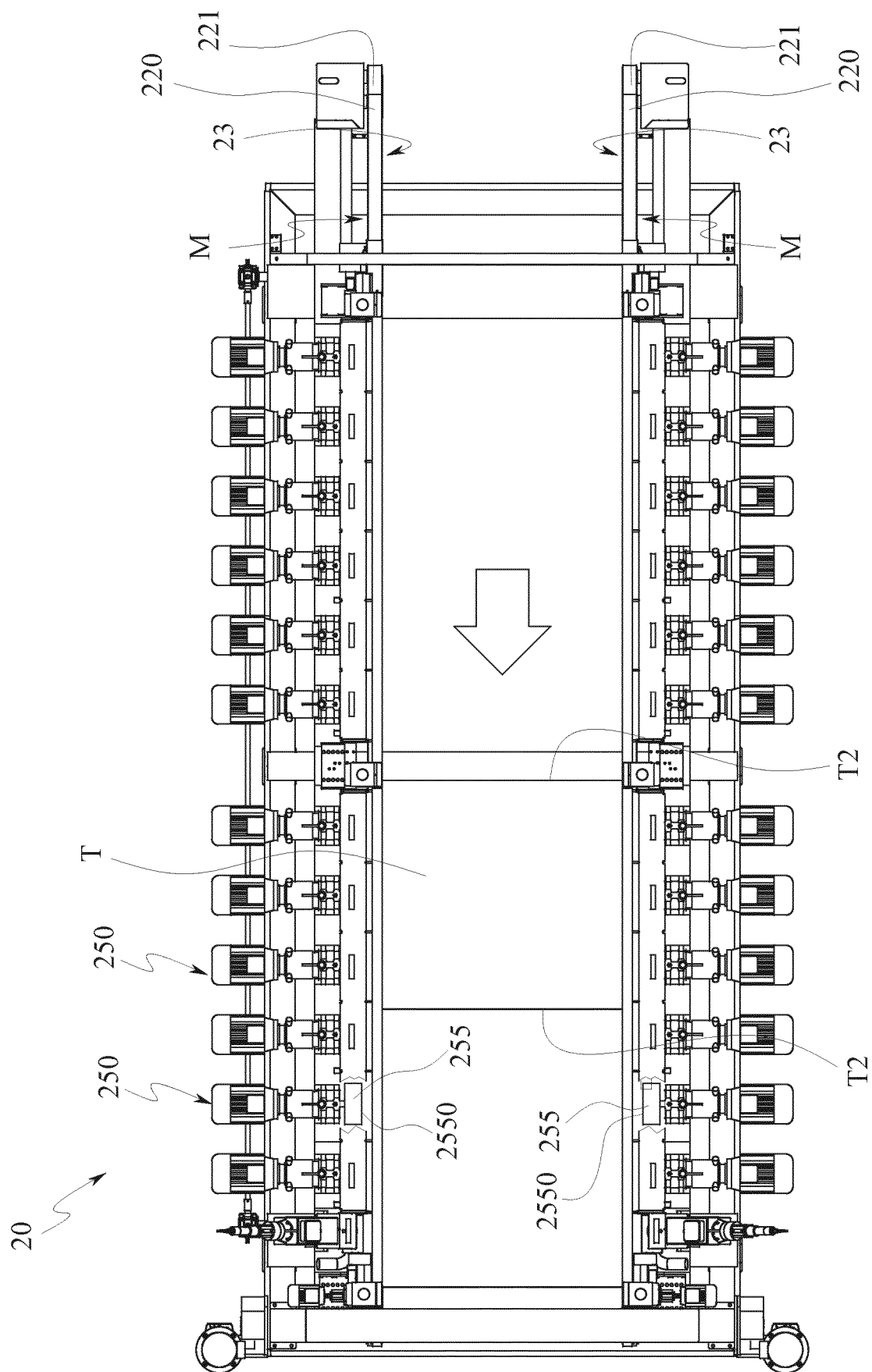


FIG. 4

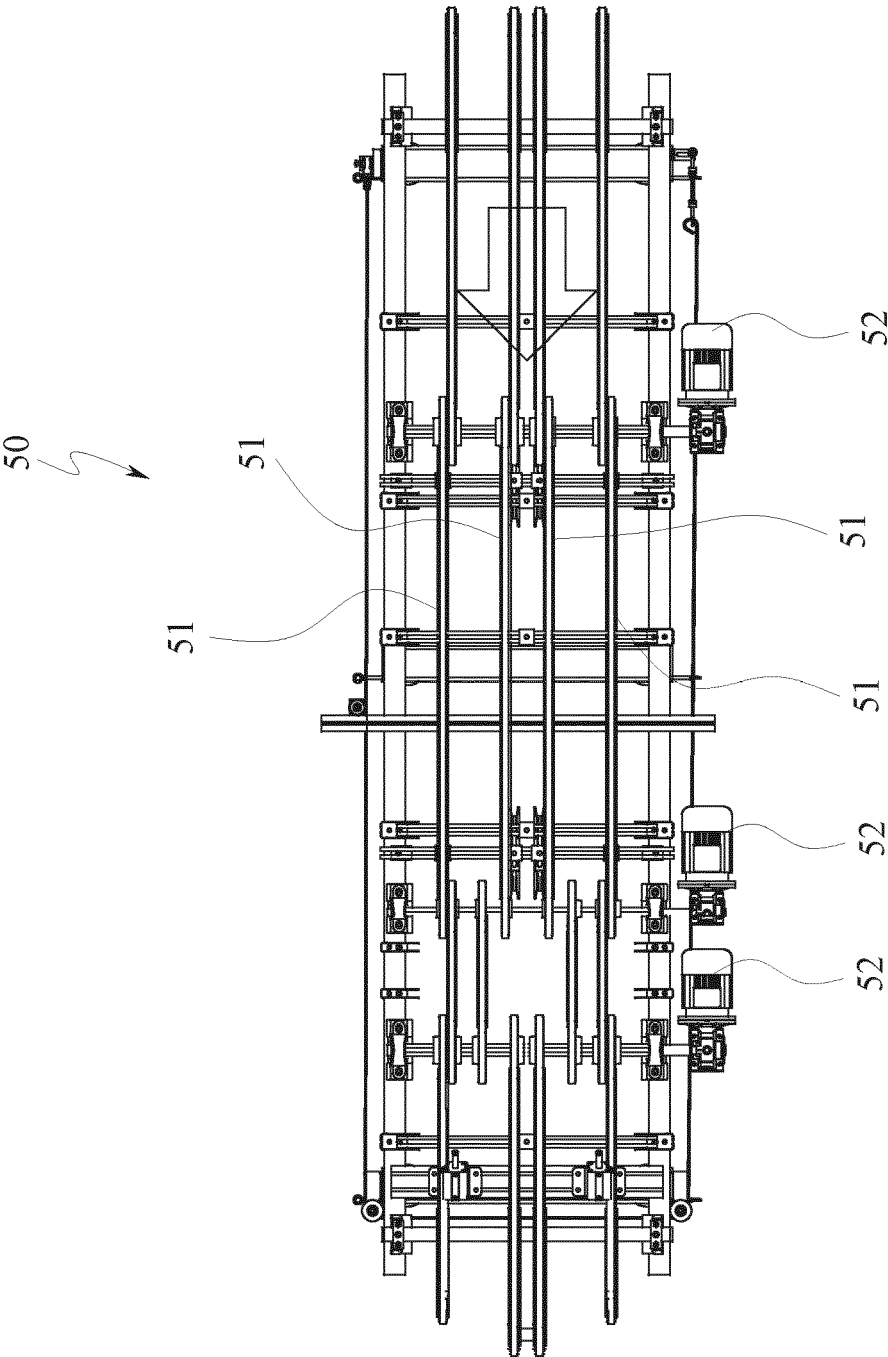


FIG. 5

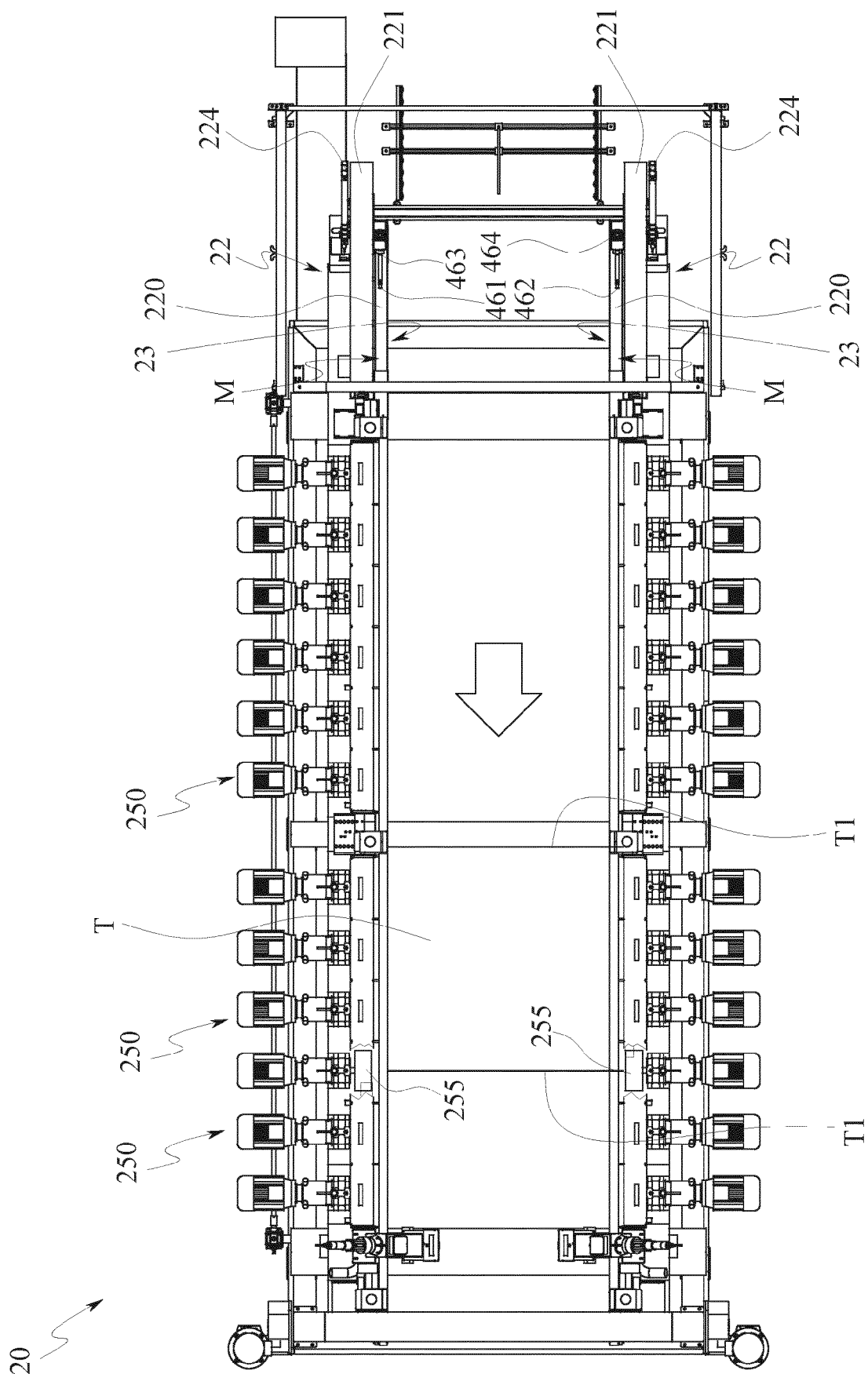


FIG. 6

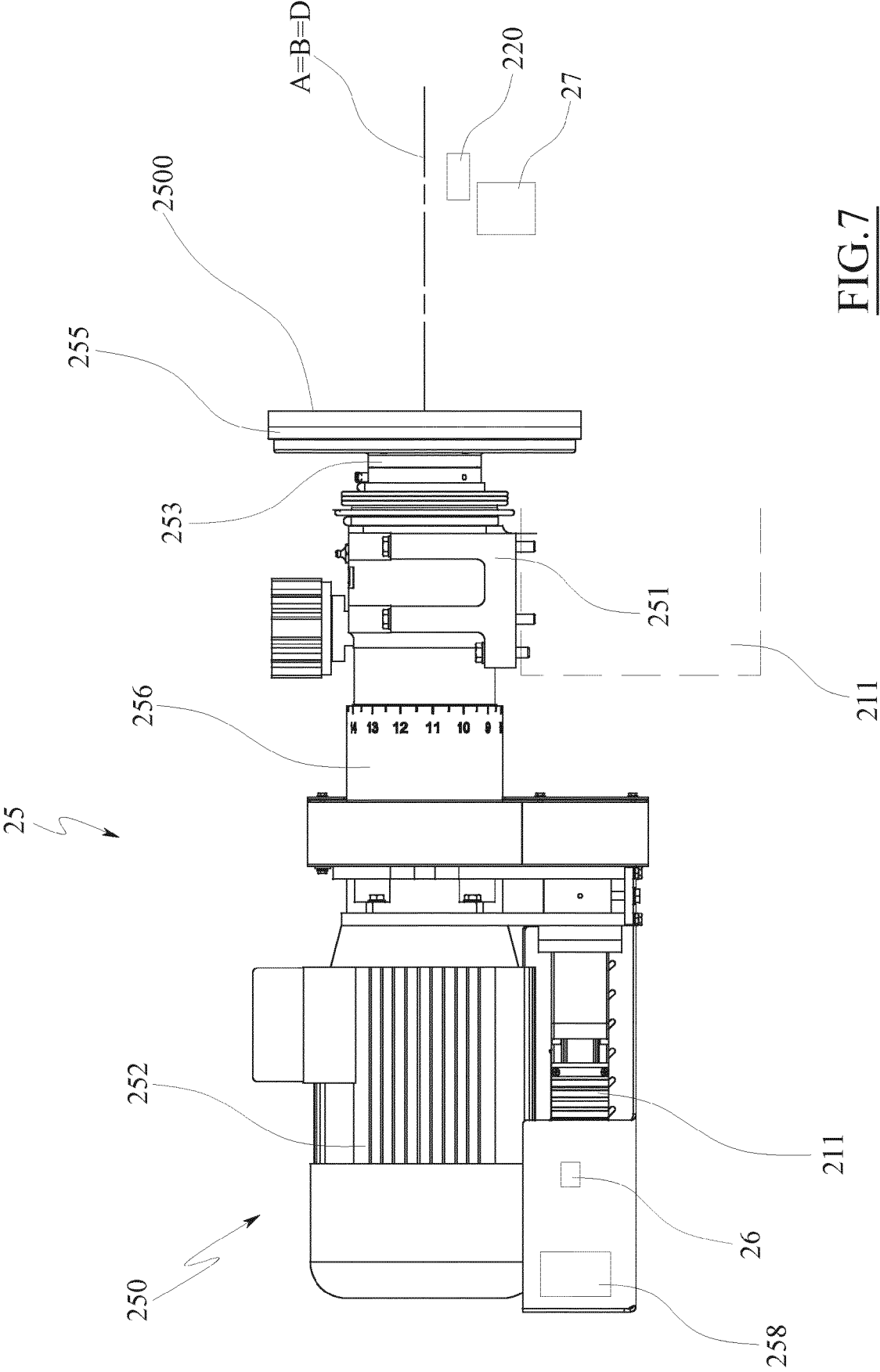


FIG. 7

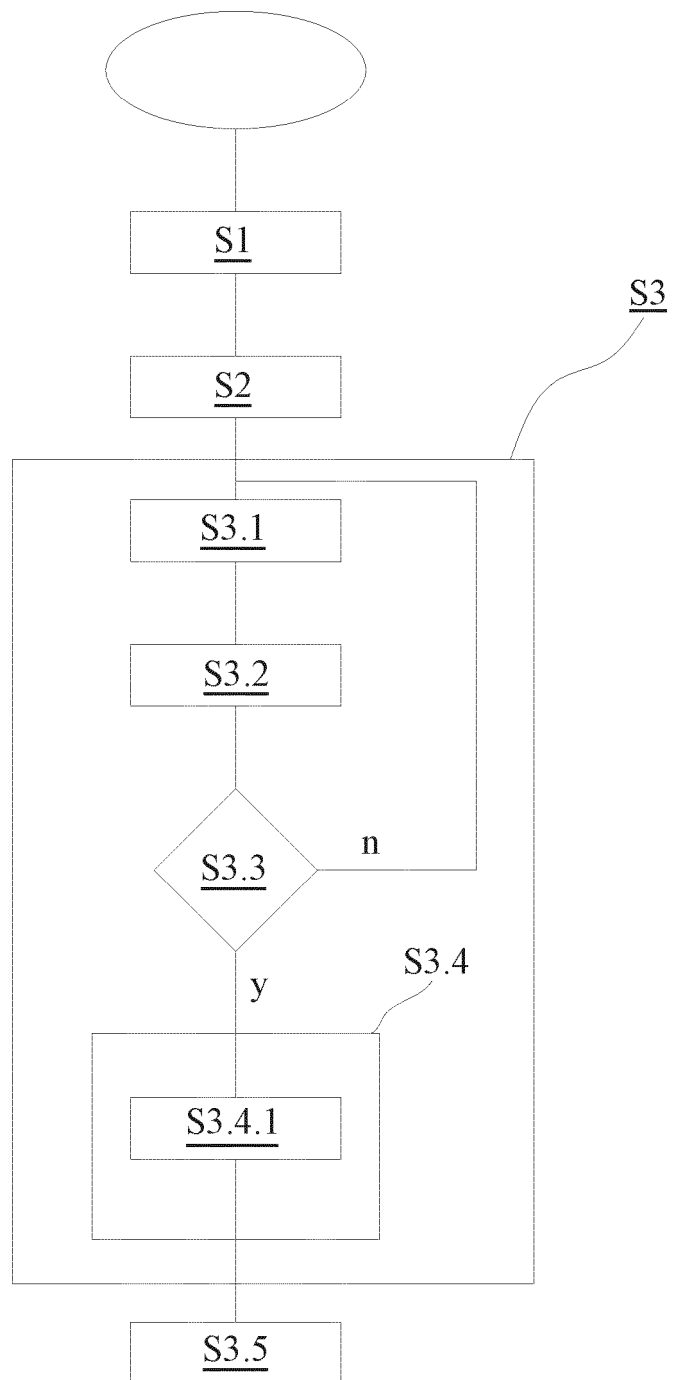


FIG.8



EUROPEAN SEARCH REPORT

Application Number
EP 21 15 1602

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
			B24B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 14 April 2021	Examiner Herrero Ramos, J
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14-04-2021

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