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

(11) EP 2 853 343 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
01.04.2015 Bulletin 2015/14

(21) Application number: **14183839.1**

(22) Date of filing: **21.02.2011**

(51) Int Cl.:
B24B 7/22 *(2006.01)* ***B24B 7/26*** *(2006.01)*
B24B 9/06 *(2006.01)* ***B24B 9/08*** *(2006.01)*
B24B 9/10 *(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

(30) Priority: **08.03.2010 IT MO20100056**

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
11713042.7 / 2 544 858

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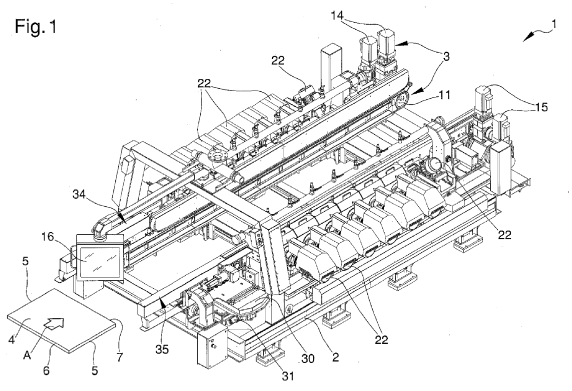
Remarks:
This application was filed on 05-09-2014 as a divisional application to the application mentioned under INID code 62.

(54) Machine for grinding plate-shaped elements, particularly tiles and slab of ceramic material, natural stones, glass or the like

(57) The machine (1) for grinding plate-shaped elements, particularly tiles and slabs of ceramic material, natural stones, glass or the like, comprises:
- a base frame (2);
- forward movement means (3) for at least a plate-shaped element (4) having at least a first side (5) to be ground and at least a second side (6) transversal to the first side (5), the forward movement means (3) being fitted on the base frame (2), being suitable for moving the plate-shaped element (4) on a movement surface (8) along a direction of forward movement (A) and comprising two pairs of flexible elements (9a, 9b; 10a, 10b), of which a first pair (9a, 9b) is fitted on a first support structure (12) and a second pair (10a, 10b) is fitted on a second support structure (13), wherein the support structures (12, 13) are associated with the base frame (2) in a reciprocal moving way, approaching and moving away along a transversal direction (B) substantially at right angles to the direction of forward movement (A);
- machining means (20, 21) for the first side (5), which are arranged in proximity of the movement surface (8) and are suitable for intercepting the plate-shaped element (4) in its movement along the direction of forward movement (A), the machining means (20, 21) comprising at least one between a side grinding wheel (20) and a chamfering wheel (21); and
- square positioning means (32, 33, 34, 35) of the plate-shaped element (4) on the movement surface (8), which comprise a first pusher (32) and a second pusher (33) moving alternately along the direction of forward movement (A) and are suitable for pushing the second side (6) to place it in a squared-up position substantially at right angles to the direction of forward movement (A), wherein the first pusher (32) is fitted on the first support structure (12) and the second pusher (33) is fitted on the second support structure (13), the pushers (32, 33) being mobile with the support structures (12, 13) along the transversal direction (B).

Fig. 1



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Description

Technical Field

[0001] The present invention relates to a machine for grinding plate-shaped elements, particularly tiles and slabs of ceramic material, natural stones, glass or the like.

Background Art

[0002] It is known that plate-shaped elements like tiles and ceramic bricks, for both floors and walls, or such as marble slabs and/or glass sheets, require a grinding operation in order to bring the sides of the products to perfect project shape or surface state.

[0003] Within the ceramic industry, for example, this operation is performed using grinding machines able to quickly machine large quantities of ceramic products that move forward in succession on a horizontal movement surface.

[0004] Traditional grinding machines in fact usually comprise a plate-shaped element moving system consisting of four conveyor belts, superimposed two by two and side by side, wherein the plate-shaped products are wedged between the lower conveyor belts and the upper conveyor belts and driven along by these.

[0005] The sides of the products to be machined protrude from the sides of the conveyor belts and, during forward movement, encounter a succession of grinding wheels, which remove the excess material and make the profile flush, and if necessary one or more sloped grinding wheels to carry out the chamfering operation.

[0006] The distance between the grinding wheels and the conveyor belts is adjustable to set the quantity of material to be removed from the products; for this purpose, a manual adjustment device is provided, of the type of a screw or the like, which can be operated by an operator.

[0007] Furthermore, at machine infeed, a centring device is provided that allows centring the plate-shaped elements with respect to the movement surface.

[0008] The centring device consists of two opposite side boards moved by means of a pair of pneumatic cylinders.

[0009] Once centred, the plate-shaped elements encounter a square positioning system which allows positioning them at right angles with respect to the direction of forward movement on the movement surface.

[0010] The square positioning system provided by traditional machines consists of a carriage which, by means of an electro-mechanical system, is alternately mobile along the direction of forward movement and which is suitable for contacting the rear side of the plate-shaped elements.

[0011] For this purpose, the carriage supports two pushers fitted on specific fine-adjustment systems, of the screw type or the like, which allow adjusting their depth along the direction of forward movement.

[0012] This way, when the products are fed into the machine, the carriage is driven in an automated way towards the plate-shaped elements, bringing the pushers into contact with the rear side of the products to push them just far enough to adjust their squared-up position.

[0013] The known machines do have a number of drawbacks.

[0014] The known machines are in fact distinguished by reduced operating flexibility and are considerably complicated as regards maintenance and settings.

[0015] More precisely, the square positioning system adopted by traditional machines requires inconvenient periodical adjustments aimed at correcting the reciprocal position of the pushers.

[0016] In such circumstances, the machine has to be stopped to allow an operator to correctly position the pushers and this is rather impractical.

[0017] To this must be added that the pushers are ready to be fitted at substantially fixed points of the support carriage and, depending on the size of the plate-shaped elements to be machined, their position may not be ideal for pushing the products.

[0018] It should not be forgotten, furthermore, that every time the size of the plate-shaped element to be ground has to be changed, adjustment must be made to the motorised drive system of the conveyor belts, the reciprocal position of the operating grinding wheels has to be changed and a new set-up must be made and all this can take several work hours.

[0019] This results in long machine down times and low outputs.

[0020] Furthermore, the correct positioning of the pushers, of the operating grinding wheels and of the conveyor belts on the machine is strongly affected by the skills of the operator carrying out such adjustments, and this means little reproducibility over time. The operators who perform such adjustment in fact have no instrument whereby to check the correct position of the pushers, of the operating grinding wheels and of the conveyor belts but have to base their jobs on their experience and/or on the noise levels of the machine and/or on the power input of the operating grinding wheels. Another problem of traditional machines consists in the fact that to transmit movement to the conveyor belts, an electric motor is usually used which is fitted on a side of the machine and which is connected to a drive shaft that transmits movement to all four conveyor belts.

[0021] Such type of drive inconveniently requires the use of numerous mechanical moving parts which are subject to wear and which, above all clutter up the central portion of the machine, where the plate-shaped elements transit, even further hindering maintenance and setting jobs performed by the operator.

[0022] In the event, for example, of having to replace one of the conveyor belts, the operator is forced to remove several parts of the machine and this takes a lot of time.

[0023] In the case, furthermore, of having to grind

large-size plate-shaped elements, the machine must, inconveniently, be equipped with a very long and cumbersome drive shaft.

[0024] Another drawback of traditional machines consists in the fact that the manual adjustment of the position of the chamfering wheels is particularly inconvenient and not at all practical.

[0025] The chamfering wheels in fact are usually fitted on a carriage prismatically sliding towards the conveyor belts, or else on a carousel hinged around a horizontal axis, the rotation of which allows moving the grinding wheel closer/further away and at the same time changing the inclination of the grinding wheel; in both cases, however, the correct positioning of the grinding wheels is particularly difficult and depends a lot on the operator's sensitivity.

[0026] It must be further underlined that sometimes, due to problems in setting the machine, reaction forces are unleashed on the plate-shaped elements being machined that are not uniform and distributed in a dissimilar way on the two sides to be ground.

[0027] To correctly maintain the square position of the plate-shaped elements during their forward movement, therefore, specific presser means are provided which press the upper conveyor belts against the lower conveyor belts to ensure the necessary treatment.

[0028] The presser means fitted in the traditional machines consist, for example, of a longitudinal bar under which the upper conveyor belt is made to slide.

[0029] To ensure the necessary traction force on the plate-shaped elements, the bar is often strongly pressed on the upper conveyor belt, causing this to wear quickly and in any case without managing to ensure a uniform distribution of the load along the entire length of the conveyor belts.

[0030] Alternatively, presser means are known composed of a succession of rollers which press on the upper conveyor belt; this solution, while on the one hand producing less wear on the conveyor belt, on the other hand results in the fact that the rollers, partially distanced the one from the other, allow applying a discontinuous pressure which, sometimes, determines the undesired movement of the plate-shaped elements with respect to their square position.

[0031] A further drawback of traditional machine consists in the fact that the device for centring the plate-shaped elements on the movement surface, which is entrusted to the operation of one/two pneumatic cylinders, is not always precise, with the risk of not correctly placing the plate-shaped elements with respect to the movement surface. Some grinding machines of known type are disclosed by patent documents EP 1 649 976, JP 1 186024 and US 6,152,809.

Description of the Invention

[0032] The main aim of the present invention is to provide a machine, for grinding plate-shaped elements, particularly tiles and slabs of ceramic material, natural stones, glass or the like that has a versatility of use sensitively higher than the known machines described above.

[0033] In particular, the present invention proposes to square up the plate-shaped elements in a much more practical, easier and more functional way, above all improving aspects tied to the adjustment of the reciprocal position of the pushers without stopping production.

[0034] A further object of the present invention is to provide a machine that can easily adapt to machining plate-shaped elements of different dimensions and which can be regulated in a practical and simple way, without long machine down times being required nor any special skills on the part of the operators.

[0035] Another object of the present invention is to provide a machine that has greater efficiency than machines of known type.

[0036] Not last object of the present invention is to provide a machine with reduced wear and limited overall dimensions/impediments, so that it is more easily accessible by the operator to carry out maintenance jobs, makes his/her work easier and cuts the time required.

[0037] Another object still of the present invention is to allow the use of grinding wheels with different wear without this negatively affecting the quality of the job done.

[0038] The possibility of using grinding wheels with a different degree of wear allows, at the same time, easier management of stocks and therefore also more economical machining.

[0039] Yet another object of the present invention is to allow the carrying out of more precise jobs, especially for large sizes, compared to machines of known type.

[0040] In particular, the machine according to the invention proposes to allow the control and adjustment of the position of the grinding wheels with respect to the movement surface and therefore with respect to the plate-shaped elements being machined.

[0041] Yet another object of the present invention is to provide a machine able to ensure the correct forward movement of the plate-shaped elements along the movement surface, without the risk of causing a rapid deterioration of the conveyor belts or losing the grip of the plate-shaped elements.

[0042] The machine according to the invention also proposes to centre the plate-shaped elements on the movement surface in a practical, easy and functional way and, above all, with much more precision compared to traditional machines.

[0043] Another object of the present invention is to provide a machine for grinding plate-shaped elements, particularly tiles and slabs of ceramic material, natural stones, glass or the like that allows overcoming the mentioned drawbacks of the background art within the ambit of a simple, rational, easy to use and low cost solution.

[0044] The present objects are achieved by the present machine for grinding plate-shaped elements, particularly tiles and slabs of ceramic material, natural stones, glass

or the like, having the features of claim 1.

Brief Description of the Drawings

[0045] Other characteristics and advantages of the present invention will become more evident from the description of a preferred, but not exclusive, embodiment of a machine for grinding plate-shaped elements, particularly tiles and slabs of ceramic material, natural stones, glass or the like, illustrated by way of example, but not limited to them, in the annexed drawings in which:

figure 1 is an axonometric view of the machine according to the invention;
figure 2 is a rear view of the machine according to the invention;
figure 3 is an axonometric view that shows in detail a portion of the forward movement means provided on the machine according to the invention;
figure 4 is an axonometric view that shows in detail the presser device of the machine according to the invention;
figure 5 is an axonometric view of a part of the machine according to the invention;
figure 6 is a plan, schematic and partial view of the part of the machine of figure 5;
figure 7 is an axonometric view of another part of the machine according to the invention;
figure 8 is a side, schematic and partial view of the part of the machine of figure 7;
figure 9 is an axonometric view of a further part of the machine according to the invention;
figure 10 is an axonometric view of yet another part of the machine according to the invention;
figures 11 and 12 show, in a succession of plan, schematic and partial views, the operation of the square positioning means of the machine according to the invention.

Embodiments of the Invention

[0046] With particular reference to such figures, by 1 is globally indicated a machine for grinding plate-shaped elements, particularly tiles and slabs of ceramic material, natural stones, glass or the like.

[0047] The machine 1 comprises a base frame 2 for resting on the ground that supports forward movement means 3 for moving at least a plate-shaped element 4, of the type of a ceramic brick and/or a marble slab or other natural stone and/or a glass plate. The plate-shaped element 4 is substantially rectangular or square and has two first opposite and parallel sides 5 to be ground, a second side 6 and a third side 7 transversal to the first sides 5.

[0048] The forward movement means 3 are suitable for moving the plate-shaped element 4 so this lies on a movement surface 8 and moves along a forward direction A, with the second side 6 arranged upstream and the third side 7 downstream with respect to the direction of forward movement A.

[0049] In particular, the forward movement means 3 comprise at least a pair of flexible elements 9a, 9b, 10a, 10b, of the type of belts, bands or the like, closed on themselves in a loop, each of which is at least partially wrapped around two drive wheels 11 and can be placed in contact on faces opposite the plate-shaped element 4 to drive this along the direction of forward movement A.

[0050] More in detail, the forward movement means 3 comprise two of the above pairs of flexible elements 9a, 9b, 10a, 10b, of which a first pair 9a, 9b is fitted on a first support structure 12 and a second pair 10a, 10b is fitted on a second support structure 13 and is arranged substantially alongside and parallel to the first pair 9a, 9b.

[0051] The flexible elements 9a, 9b of the first pair are arranged one above the other and extend parallel to the direction of forward movement A; similarly, the flexible elements 10a, 10b of the second pair are arranged one above the other and are facing the first pair 9a, 9b in a substantially symmetrical way with respect to a vertical plane parallel to the direction of forward movement A.

[0052] During use, the plate-shaped element 4 is meant to rest on the lower flexible elements 9a, 10a wedging underneath the upper flexible elements 9b, 10b.

[0053] For this purpose, the lower flexible elements 9a, 10a are longer and have a free entry section on which to rest the plate-shaped element 4 before wedging underneath the upper flexible elements 9b, 10b.

[0054] The movement surface 8 consists in the surface defined between the lower flexible elements 9a, 10a and the upper flexible elements 9b, 10b (figure 2).

[0055] In the particular embodiment shown in the illustrations, the movement surface 8 is substantially horizontal, as is the direction of forward movement A, but alternative embodiments cannot be ruled out wherein the movement surface 8 is inclined.

[0056] In this respect, it must be pointed out that, in the present treatise, some elements of the machine 1 are defined "horizontal" or "vertical" inasmuch as in the embodiment shown in the illustrations, the movement surface 8 is horizontal; as can be easily appreciated, however, in the case of the movement surface 8 being inclined the expert person in the sector could make the same considerations on the elements of the machine 1 depending on the position of the movement surface 8.

[0057] Usefully, the flexible elements 9a, 9b of the first pair are associated with at least a first operating motor 14 while the flexible elements 10a, 10b of the second pair are associated with at least a second operating motor 15.

[0058] More in detail, there are two first operating motors 14, one for each flexible element 9a, 9b of the first pair, while there are two second operating motors 15, one for each flexible element 10a, 10b of the second pair.

[0059] The first operating motors 14 and the second operating motors 15 are of the electric type and are electronically connected to a processing and control unit 16

suitable for controlling the relevant movement and, in particular, the synchronism to ensure constant and regular forward movement.

[0060] The support structures 12, 13 extend longitudinally and parallel to the direction of forward movement A and are associated with the base frame 2 in a reciprocally moving way, approaching and moving away along a transversal direction B which is horizontal and substantially at right angles to the direction of forward movement A. This, in practice, allows bringing the flexible elements 9a, 9b, 10a, 10b closer together and, therefore, reducing or enlarging the movement surface 8 according to the size of the plate-shaped element 4.

[0061] The forward movement means 3, furthermore, comprise a presser device 17, 18, 19 suitable for pushing the flexible elements 9a, 9b, 10a, 10b of each pair the one against the other.

[0062] The presser device 17, 18, 19 provided on the machine 1, in particular, comprises a pair of support bars 17 which are arranged inside the upper flexible elements 9b, 10b and supporting a plurality of guide runners 18 arranged in succession and substantially adjacent the one to the other along the direction of forward movement A.

[0063] The guide runners 18 are designed to be pressed against the upper flexible elements 9b, 10b to push them against the respective lower flexible elements 9a, 10a.

[0064] Between the support bars 17 and the guide runners 18 are placed elastic means, of the type of a series of springs 19 suitable for cushioning the pressure of the guide runners 18 on the upper flexible elements 9b, 10b.

[0065] In the proximity of the movement surface 8 machining means 20, 21 are arranged of the first sides 5 of the plate-shaped element 4, which are suitable for intercepting the plate-shaped element 4 in its movement along the direction of forward movement A. The machining means 20, 21 e.g., comprise a plurality of side grinding wheels 20 arranged on both sides of the movement surface 8.

[0066] The side grinding wheels 20 are split up into a first series fitted on the first support structure 12 and into a second series fitted on the second support structure 13.

[0067] The side grinding wheels 20 are driven in rotation around an axis substantially horizontal and at right angles to the direction of forward movement A by means of a corresponding control motor 22.

[0068] The control motors 22 and the side grinding wheels 20 are also mobile in approaching and moving away with respect to the movement surface 8 and are provided with automated adjustment means 23 suitable for adjusting the position of the side grinding wheels 20 with respect to the surface itself.

[0069] The automated adjustment means 23 are of the optical/visual type and comprise emission/receiving means 24, 25 for emitting/receiving a rectilinear light ray 26, arranged at a preset distance from the movement surface 8 and suitable for being interrupted by the side grinding wheels 20 by effect of the approaching/moving away of the side grinding wheels 20 with respect to the movement surface 8.

[0070] The emission/receiving means 24, 25, e.g., consist in a pair of laser emitters 24 fitted at a longitudinal extremity of the support structures 12, 13 and in a corresponding pair of laser receivers 25 fitted at the opposite longitudinal extremity of the support structures 12, 13.

[0071] The laser ray 26 emitted by the laser emitters 24 is substantially directed parallel to the direction of forward movement A.

[0072] Alternative embodiments cannot however be ruled out wherein the automated adjustment means 23 comprise other types of optical devices such as cameras or the like for detecting the position of the side grinding wheels 20.

[0073] To register the position of the side grinding wheels 20 means are also provided for detecting the position of the side grinding wheels 20 in correspondence to which the side grinding wheels 20 interrupt the laser ray 26.

[0074] For this purpose, it is underlined that the control motors 22 and the side grinding wheels 20 are associated with an equal number of operating devices 27 to move the side grinding wheels 20 in approaching and moving away with respect to the movement surface 8, the operating devices 27 being electronically connected to the processing and control unit 16 for controlling the position of the side grinding wheels 20 according to the measurement detected by the detection means.

[0075] In particular, the operating devices 27 consist in an equal number of electric motors able to automatically detect their position to inform in agreement the processing and control unit 16.

[0076] The machining means 20, 21, furthermore, comprise two chamfering wheels 21 arranged on opposite sides of the movement surface 8, one of which is fitted on the first support structure 12 and the other on the second support structure 13.

[0077] The chamfering wheels 21 are driven in rotation around an axis substantially oblique with respect to the movement surface 8 and at right angles to the direction of forward movement A by means of a corresponding control motor 22.

[0078] More in detail, the control motors 22 and the chamfering wheels 21 are supported by an articulated parallelogram mechanism 28 suitable for guiding each chamfering wheel 21 in an approach and away movement with respect to the movement surface 8.

[0079] In particular, the articulated parallelogram mechanism 28 comprises a pair of connecting rods placed in between the control motor 22 of the chamfering wheels 21 and the corresponding support structure 12, 13, the control motor 22 being connected to an electric motor 29 identical to the operating devices 27.

[0080] Usefully, for the correct positioning of the plate-shaped element 4 on the movement surface 8, the machine I is fitted with centring means 30, 31 for centring

the plate-shaped element 4 which comprise two side boards 30 arranged on opposite sides of the movement surface 8 and which can be operated in approach and away movement with respect to the movement surface 8 by means of two respective electric motors 31.

[0081] In particular, a side board 30 is fitted on the first support structure 12 while the other side board 30 is fitted on the second support structure 13.

[0082] On the side boards 30 are fitted bumper discs 30a suitable for contacting the first sides 5 of the plate-shaped element 4.

[0083] The electric motors 31 associated with the side boards 30 are electrically connected to the processing and control unit 16 to control their relative and synchronous operation, so as to ensure a centring precision considerably greater than that of traditional machines.

[0084] Advantageously, the machine 1 also comprises square positioning means 32, 33, 34, 35, suitable for positioning the plate-shaped element 4 on the movement surface 8 in a square position wherein the second side 6 of the plate-shaped element 4 is placed substantially at right angles to the direction of forward movement A.

[0085] The square positioning means 32, 33, 34, 35 comprise a first pusher 32 and a second pusher 33 which are alternately mobile along the direction of forward movement A and are suitable for pushing the second side 6 of the plate-shaped element 4 and positioning it in the above square position.

[0086] The square positioning means 32, 33, 34, 35 also comprise a first linear actuator 34 suitable for operating the first pusher 32 along the direction of forward movement A and a second linear actuator 35 suitable for operating the second pusher 33 along the direction of forward movement A.

[0087] The linear actuators 34, 35 are separate and independent the one from the other and electronically connected to the processing and control unit 16, which is suitable for controlling the relevant movement.

[0088] The processing and control unit 16, in point of fact, is able to command the forward movement of the pushers 32, 33 in an automated way and, above all, to control their movement synchronism, on which depends the position of the second side 6 of the plate-shaped element 4.

[0089] The linear actuators 34, 35, in particular, consist in an electric motor 37 (figure 10), e.g., of the brushless type, which drives a driving shaft 38 in rotation.

[0090] The driving shaft 38 is designed to drive a flexible body 39, of the type of a belt or the like, closed on itself in a loop around two wheels 40 one of which fitted on the driving shaft 38, and not shown in the illustrations, and the other idle.

[0091] To the flexible body 39 is rigidly associated a connection element 41 which supports a bracket 42 which, in turn, supports one of the pushers 32, 33.

[0092] The flexible bodies 39 used in each linear actuator 34, 35 are arranged along the direction of forward movement A so the pushers 32, 33 can run parallel to it.

[0093] The processing and control unit 16, in actual fact, acts as an "electric" drive shaft that permits maintaining the synchronism of operation of the electric motors 37 and the consequent forward movement of the pushers 32, 33.

[0094] More in detail, the first linear actuator 34 is fitted on the first support structure 12 while the second linear actuator 35 is fitted on the second support structure 13 and these are mobile with them along the transversal direction B.

[0095] This, in point of fact, allows changing, in an easy and functional way, the reciprocal distance of the linear actuators 34, 35 and of the pushers 32, 33 according to the size of the plate-shaped element 4 being machined.

[0096] Usefully, the first pusher 32 is arranged in correspondence to the first pair of flexible elements 9a, 9b and the second pusher 33 is arranged in correspondence to the second pair of flexible elements 10a, 10b; more in detail, each pusher 32, 33 lies on the vertical lying plane of the respective pair of flexible elements 9a, 9b, 10a, 10b and moves alternately forward and backward along the free entry section of the lower flexible elements 9a, 10a.

[0097] Quite apart from the size of the products being machined, therefore, each pusher 32, 33 is able to push the plate-shaped element 4 precisely in correspondence to the lower flexible elements 9a, 10a, to make this slide on the movement surface 8 and correct the position of the second side 6 in the most controlled and precise way possible.

[0098] The first pusher 32 and the second pusher 33 consist, e.g., in a lever which is fitted at the moving extremity of the linear actuators 34, 35, supports a roller 36 and is suitable for entering into contact with the second side 6 once the plate-shaped element 4 has fully passed underneath the pushers 32, 33.

[0099] The operation of the present invention is the following.

[0100] Initially, the machine 1 is set by an operator according to the size of the plate-shaped element 4 to be machined. For this purpose, it is enough to adjust the distance of the support structures 12, 13 along the transversal direction B, dragging with them the machining means 20, 21, the automated adjustment means 23, the centring means 30, 31 and the square positioning means 32, 33, 34, 35.

[0101] By means of the automated adjustment means 23 a sampling is made of the machining means 20, 21 to detect their state of wear and the relevant distance from the movement surface 8.

[0102] To operate in this sense, the machining means 20 and 21 are first of all placed at the maximum distance from the movement surface 8 and then made to move forward one by one towards the corresponding laser ray 26.

[0103] When each machining means 20, 21 interrupts the laser ray 26, the processing and control unit 16 samples its position with respect to the corresponding oper-

ating device 27.

[0104] Taking into account the fact that the part of the side grinding wheels 20 or of the chamfering wheels 21 which interrupts the laser ray 26 consists in their active surface, i.e., the abrasive surface, it follows that the above sampling permits performing a precise positioning of the wheels and correcting, in a practical and automated way, any errors caused by wear.

[0105] Once the side grinding wheels 20 have been positioned and, similarly, also the chamfering wheels 21, the plate-shaped element 4 to be machined is loaded on the free entry section of the lower flexible elements 9a, 10a where, by means of the centring means 30, 31, it is centred with respect to the movement surface 8.

[0106] At this point, the plate-shaped element 4 is transported along the direction of forward movement A and made to pass underneath the pushers 32, 33, and after passing these is ready to be positioned squared-up.

[0107] For this purpose, the processing and control unit 16 controls the operation of the linear actuators 34, 35 and controls the forward movement of the pushers 32, 33, which come into contact with the second side 6 and push the plate-shaped element 4 to slide on the lower flexible elements 9a, 10a until the square position is reached wherein the second side 6 is perfectly at right angles to the direction of forward movement A.

[0108] Once the plate-shaped element 4 has wedged between the lower flexible elements 9a, 10a and the upper flexible elements 9b, 10b, it is withheld in the square position by effect of the thrust exercised by the guide runners 18 and made to move forward along the direction of forward movement A encountering along the way the machining means 20, 21 which perform the necessary grinding and chamfering operations.

[0109] It has in practice been ascertained how the described invention achieves the proposed objects.

[0110] In this respect, it is underlined that the particular solution of providing two linear actuators for the independent movement of the pushers, whose operation and control is entrusted to a processing and control unit allows managing, in a practical and easy way, the setting of the machine relating to the square positioning of the plate-shaped elements, and allows making any corrections without the need to stop the machine.

[0111] In the same way, it is pointed out that the particular solution of providing two independent centring elements, the operation and control of which is entrusted to a processing unit that allows the relative and synchronous movement and allows obtaining a high positioning precision of the plate-shaped element.

[0112] It is also pointed out that the particular solution of providing four flexible elements driven by a respective operating motor allows splitting the machine into two completely independent support structures and reducing the number of moving mechanical parts, making it possible to leave the central part of the machine substantially free so as to simplify maintenance jobs by the operator.

[0113] The fact of providing two reciprocally mobile support structures mounting linear actuators for the independent movement of the pushers, and of the grinding wheels, the centring side boards and the emission/receiving means permits changing the configuration of the machine according to the size of the plate-shaped element being machined with a single, quick, easy and functional operation.

[0114] It should not be forgotten on the other hand that the particular solution of providing a laser ray to detect the position of the grinding wheels allows setting their position in a practical, functional and above all reliable way, with the certainty of obtaining the precision needed for the operation and without the need to rely on the discretion and sensitivity of skilled labour.

[0115] It is also pointed out that the particular solution of providing a succession of guide runners pressing on the flexible elements permits uniformly distributing the load applied along the entire length of the machine, without excessive wear on the flexible elements and at the same time ensuring the necessary pressure on these.

[0116] Nor furthermore should the fact be ignored that the use of an articulated-parallelogram mechanism for the movement of the chamfering wheels permits performing such operation with great precision and accuracy, without the difficulties that affect traditional machines.

[0117] Finally, the fact is underlined that the adoption of a processing and control unit to control all the machine functions permits ensuring great operating precision both during machine setting and during the machining of the plate-shaped elements.

Claims

1. Machine (1) for grinding plate-shaped elements, particularly tiles and slabs of ceramic material, natural stones, glass or the like, comprising:

   - at least a base frame (2);
   - forward movement means (3) for at least a plate-shaped element (4) having at least a first side (5) to be ground and at least a second side (6) transversal to said first side (5), said forward movement means (3) being fitted on said base frame (2) and being suitable for moving said plate-shaped element (4) on at least a movement surface (8) along at least a direction of forward movement (A), wherein:
   - said forward movement means (3) comprise at least a pair of flexible elements (9a, 9b; 10a, 10b) closed on themselves like a loop, each of which is wrapped at least in part around two operating wheels (11) and can be placed in contact on opposite faces of said plate-shaped element (4) to drive it along said direction of forward movement (A); and
   - said forward movement means (3) comprise at least two of said pairs of flexible elements (9a,

9b; 10a, 10b), of which a first pair (9a, 9b) is fitted on a first support structure (12) and a second pair (10a, 10b) is fitted on a second support structure (13) and is arranged substantially alongside and parallel to said first pair (9a, 9b); and

- machining means (20, 21) for machining said first side (5), which are arranged in proximity of said movement surface (8) and are suitable for intercepting said plate-shaped element (4) in its movement along said direction of forward movement (A), said machining means (20, 21) comprising at least one between a side grinding wheel (20) and a chamfering wheel (21);

characterised by the fact that:

- said support structures (12, 13) are associated with said base frame (2) in a reciprocal moving way, approaching and moving away along a transversal direction (B) substantially at right angles to said direction of forward movement (A);
- said machine (1) comprises square positioning means (32, 33, 34, 35) of said plate-shaped element (4) on said movement surface (8), which comprise at least a first pusher (32) and at least a second pusher (33) moving alternately along said direction of forward movement (A) and are suitable for pushing said second side (6) to place it in a squared-up position substantially at right angles to said direction of forward movement (A); and
- said first pusher (32) is fitted on said first support structure (12) and said second pusher (33) is fitted on said second support structure (13), wherein said pushers (32, 33) are mobile with said support structures (12, 13) along said transversal direction (B) allowing changing the reciprocal distance of said pushers (32, 33) according to the size of said plate-shaped element (4) being machined.

2. Machine (1) according to the claim 1, **characterised by** the fact that said square positioning means (32, 33, 34, 35) comprise a first linear actuator (34) suitable for operating said first pusher (32) and a second linear actuator (35) suitable for operating said second pusher (33), said linear actuators (34, 35) being separated and independent the one from the other and electronically connected to a processing and control unit (16) suitable for controlling their relative movement,

3. Machine (1) according to the claim 2, **characterised by** the fact that at least one between said first linear actuator (34) and said second linear actuator (35) comprises an electric motor (37) for operating in rotation a driving shaft (38) which is intended to operate sliding at least a supporting bracket (42) for at least one of said pushers (32, 33).

4. Machine (1) according to the claim 3, **characterised by** the fact that said electric motor (37) is of the brushless type.

5. Machine (1) according to one of the preceding claims, **characterised by** the fact that at least one between said first pusher (32) and said second pusher (33) comprises a lever which is fitted at the mobile extremity of said linear actuators (34, 35).

6. Machine (1) according to one of the preceding claims, **characterised by** the fact that said forward movement means (3) comprise at least a presser device (17, 18, 19) suitable for pushing at least one of said flexible elements (9a, 9b; 10a, 10b) against the other.

7. Machine (1) according to the claim 6, **characterised by** the fact that said presser device (17, 18, 19) comprises a plurality of guide runners (18) arranged in succession and substantially adjacent the one to the other along said direction of forward movement (A).

8. Machine (1) according to the claim 7, **characterised by** the fact that said presser device (17, 18, 19) comprises elastic means (19) for cushioning the pressure of said guide runners (18).

9. Machine (1) according to one of the preceding claims, **characterised by** the fact that the flexible elements of said first pair (9a, 9b) are associated with at least a first operating motor (14) and the flexible elements of said second pair (10a, 10b) are associated with at least a second operating motor (15), said first operating motor (14) and said second operating motor (15) being connected to said processing and control unit (16) suitable for controlling their relative movement.

10. Machine (1) according to the claim 9, **characterised by** the fact that said first operating motors (14) are two, one for each flexible elements of said first pair (9a, 9b), and said second operating motors (15) are two, one for each flexible elements of said second pair (10a, 10b).

11. Machine (1) according to one of the claims from 2 to 10, **characterised by** the fact that said first linear actuator (34) is fitted on said first support structure (12) and said second linear actuator (35) is fitted on said second support structure (13).

12. Machine (1) according to one of the preceding claims, **characterised by** the fact that said first pusher (32) is arranged in correspondence to said first pair of flexible elements (9a, 9b) and said second pusher (33) is arranged in correspondence to said second pair of flexible elements (10a, 10b).

13. Machine (1) according to claim 12, **characterised by** the fact that each pusher (32, 33) lies on the vertical lying plane of the respective pair of flexible elements (9a, 9b, 10a, 10b) and moves alternately forward and backward along a free entry section of one of said flexible elements (9a, 1 ova).

14. Machine (1) according to one of the preceding claims, **characterised by** the fact that said grinding or chamfering wheels (20, 21) are mobile in approaching and moving away with respect to said movement surface (8) and by the fact that it comprises automated adjustment means (23) suitable for adjusting the position of said grinding or chamfering wheels (20, 21) with respect to said movement surface (8) and electronically connected to said processing and control unit (16) which is suitable for controlling their operation.

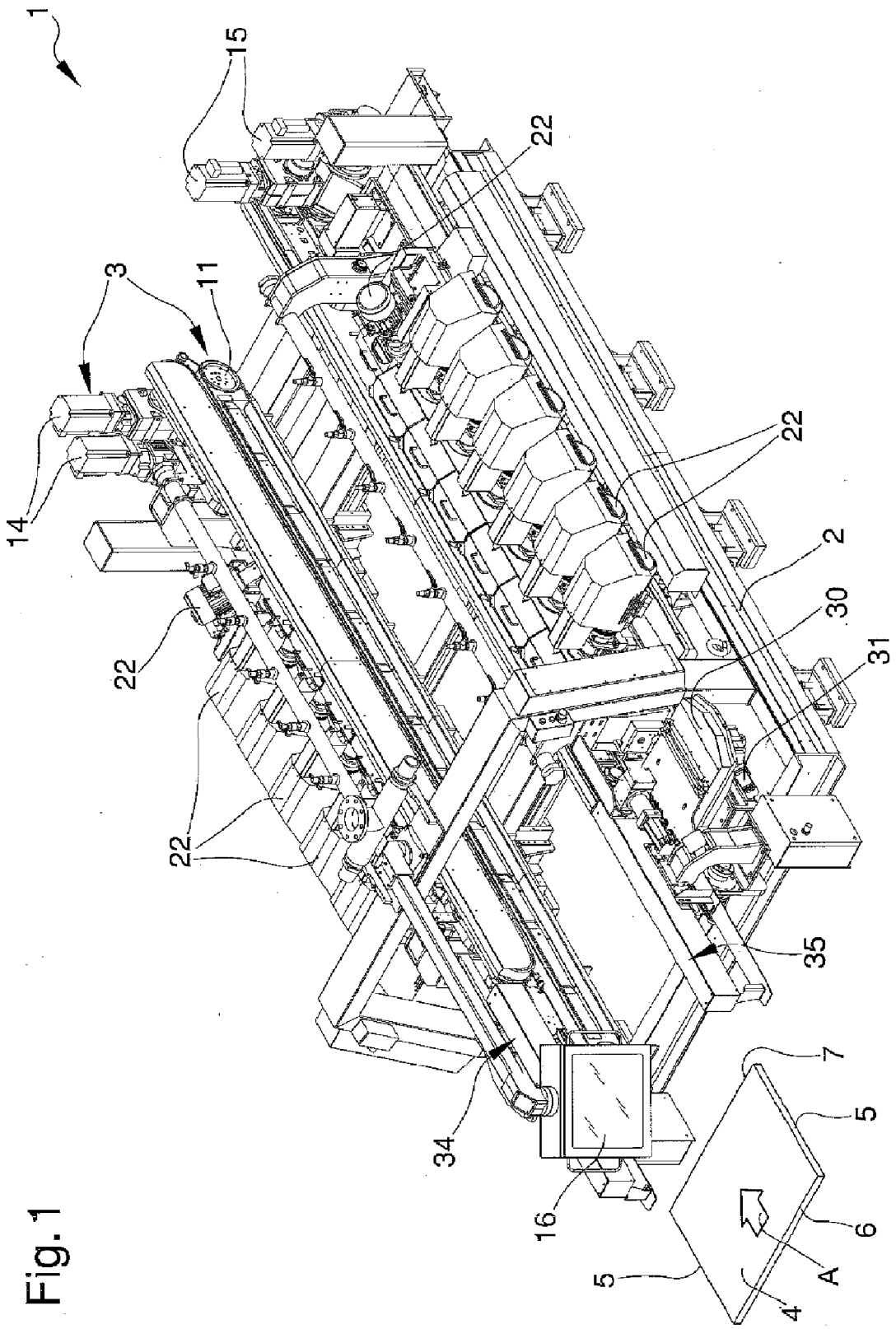


Fig. 1

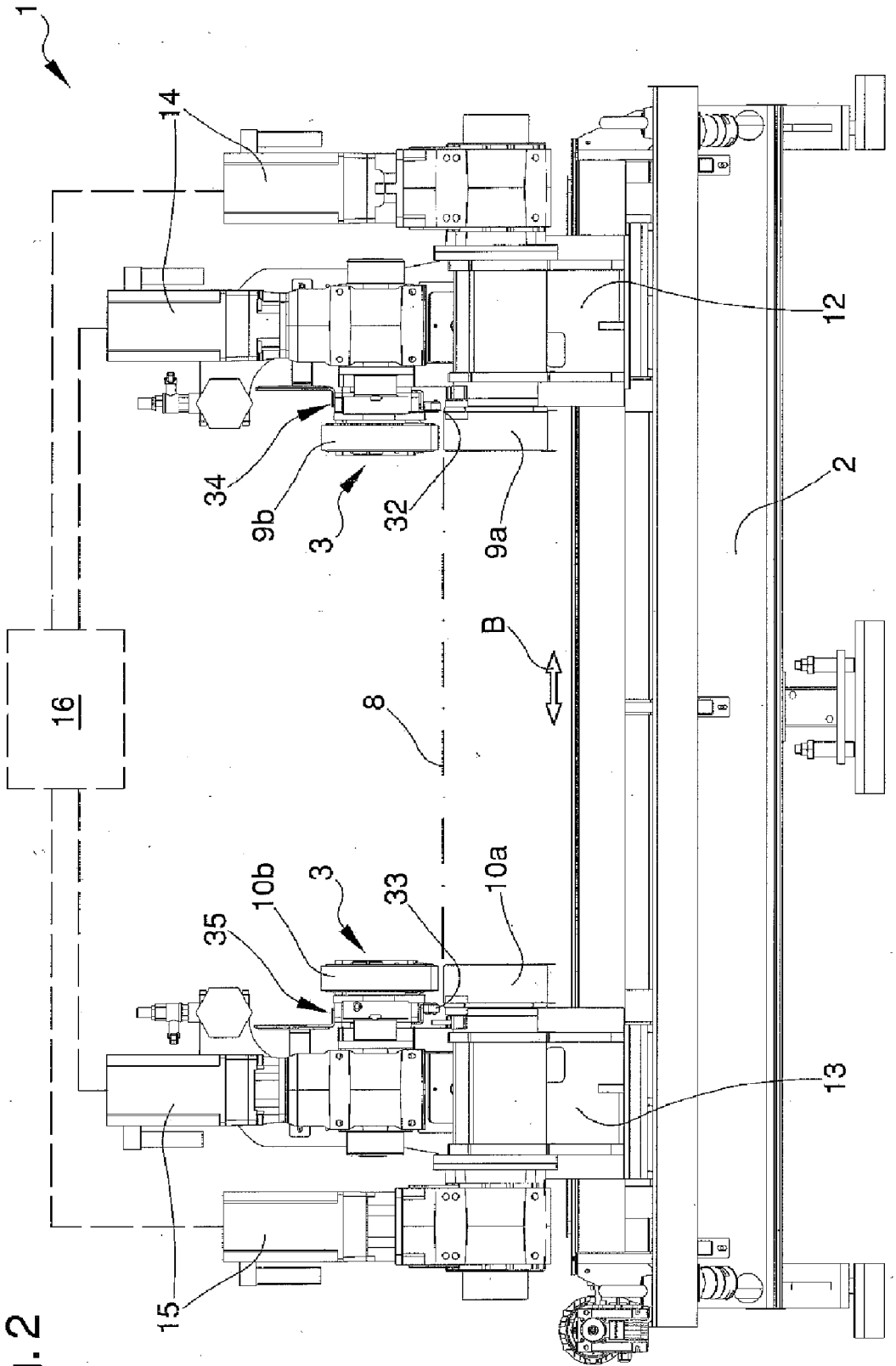


Fig. 2

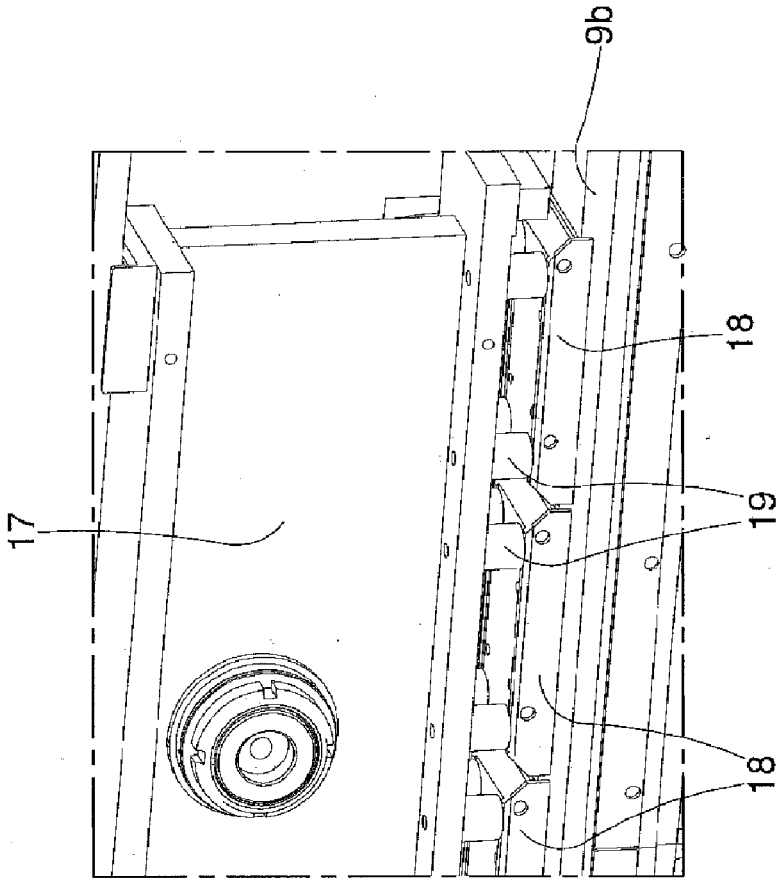


Fig. 4

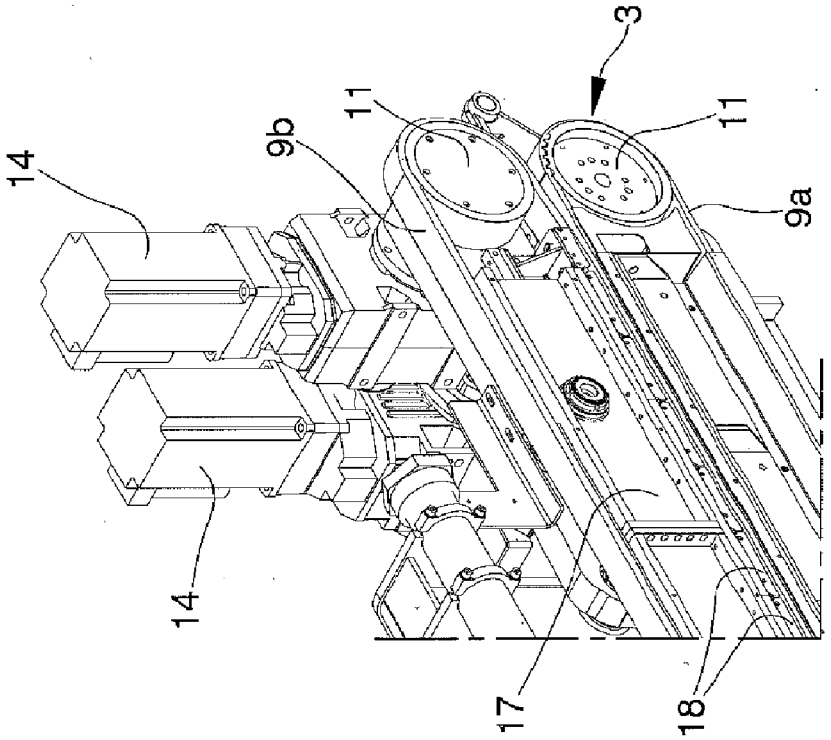


Fig. 3

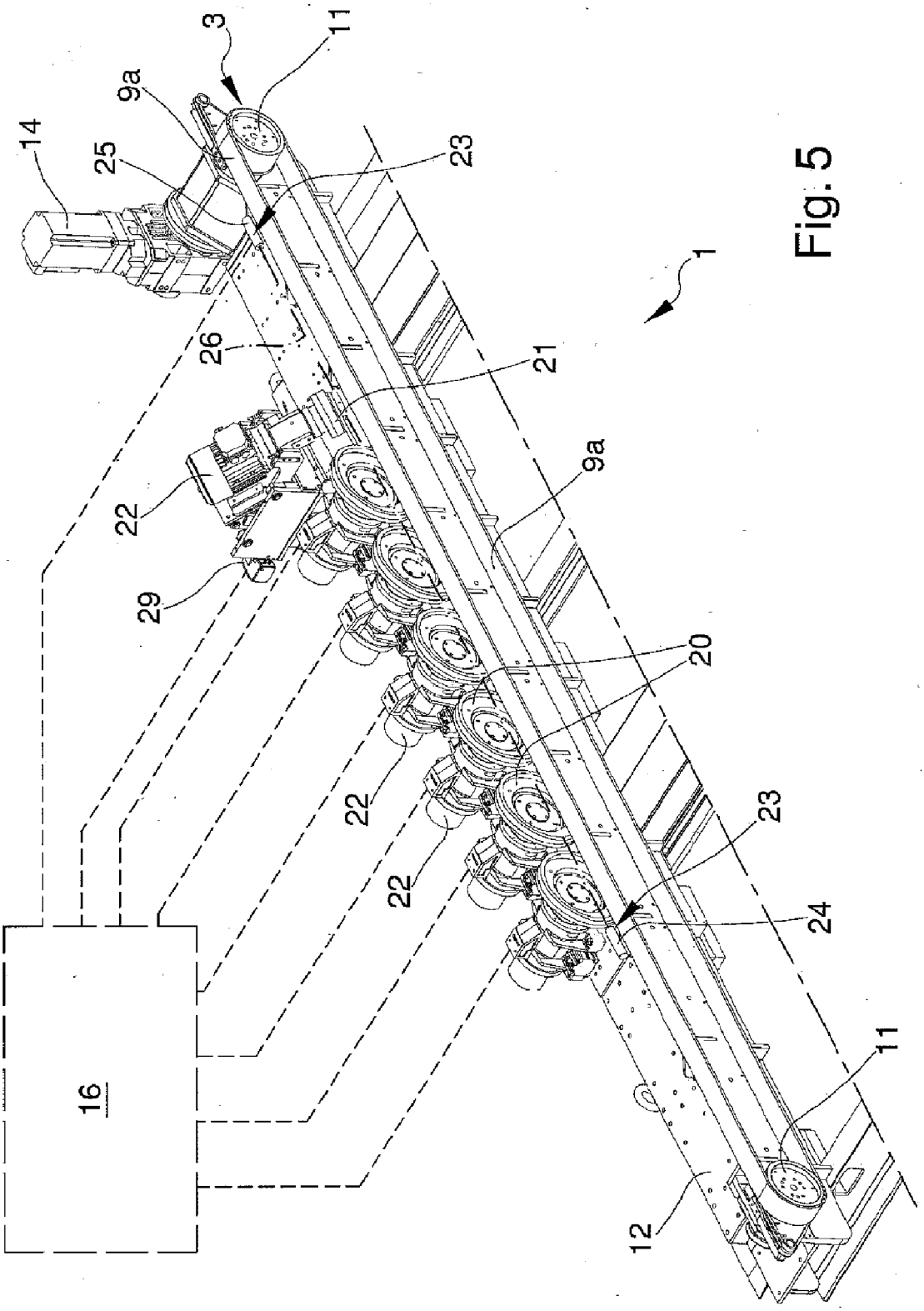


Fig. 5

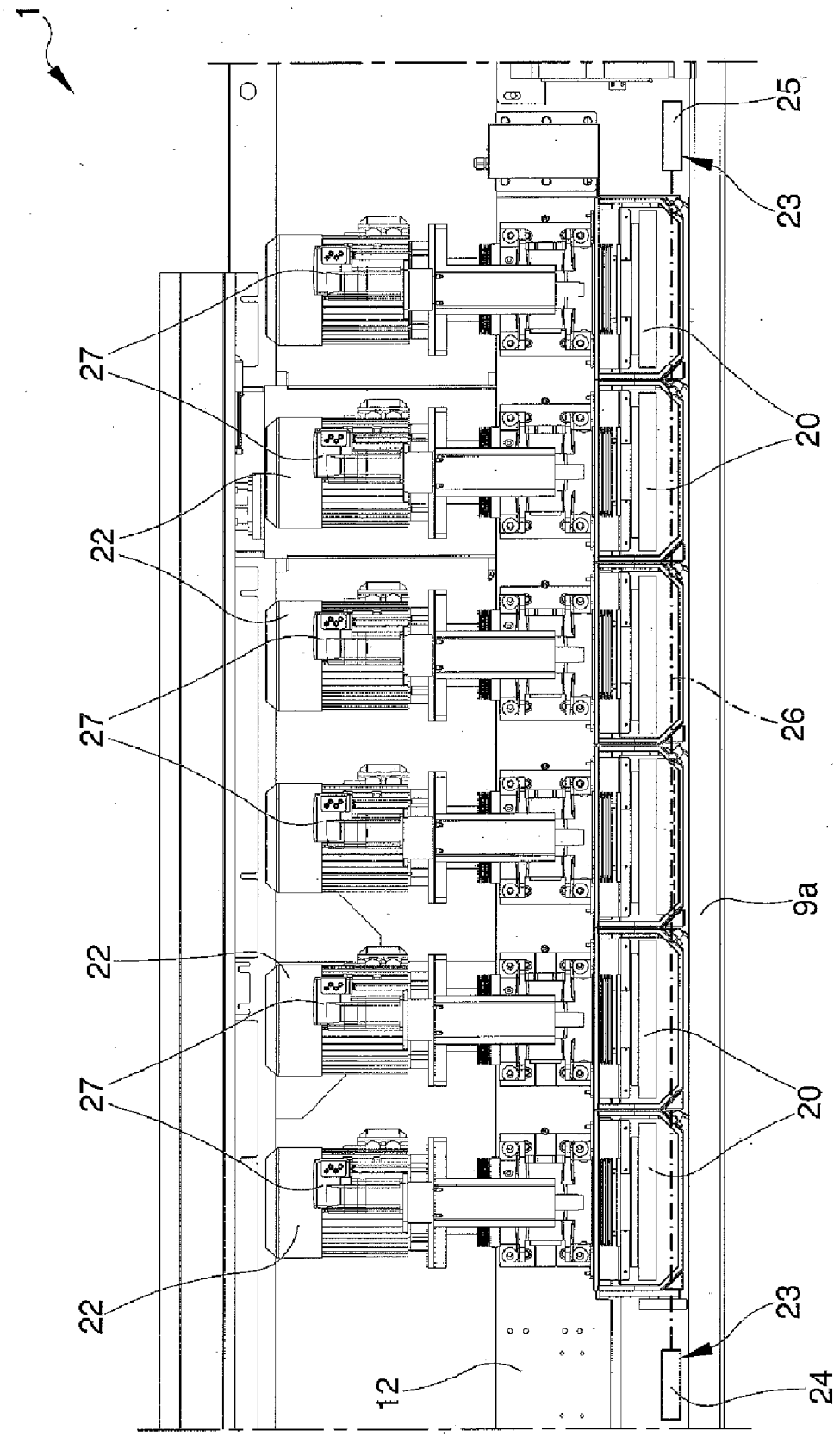


Fig. 6

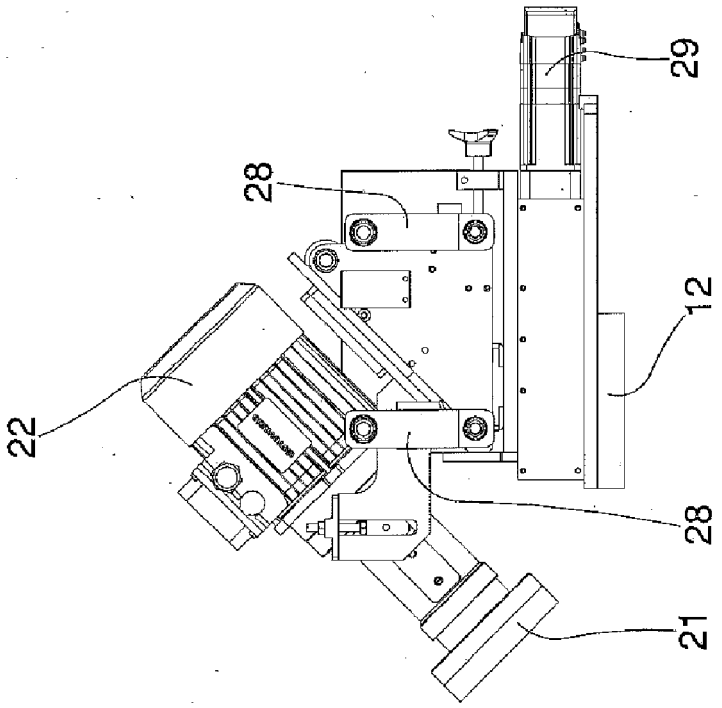


Fig. 8

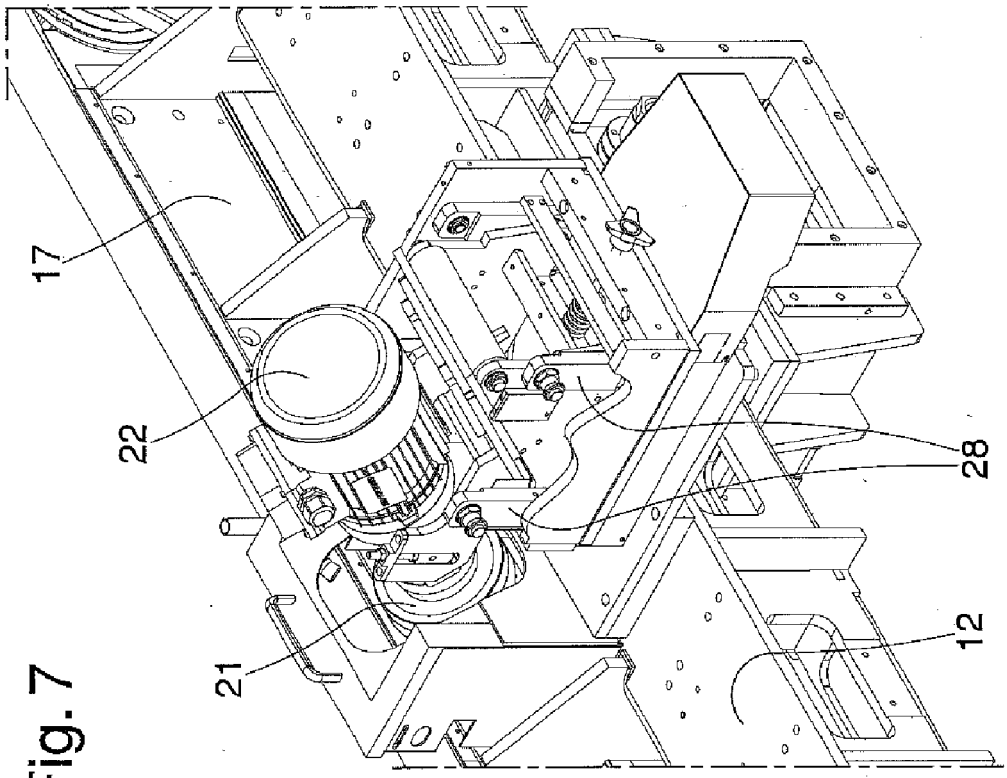
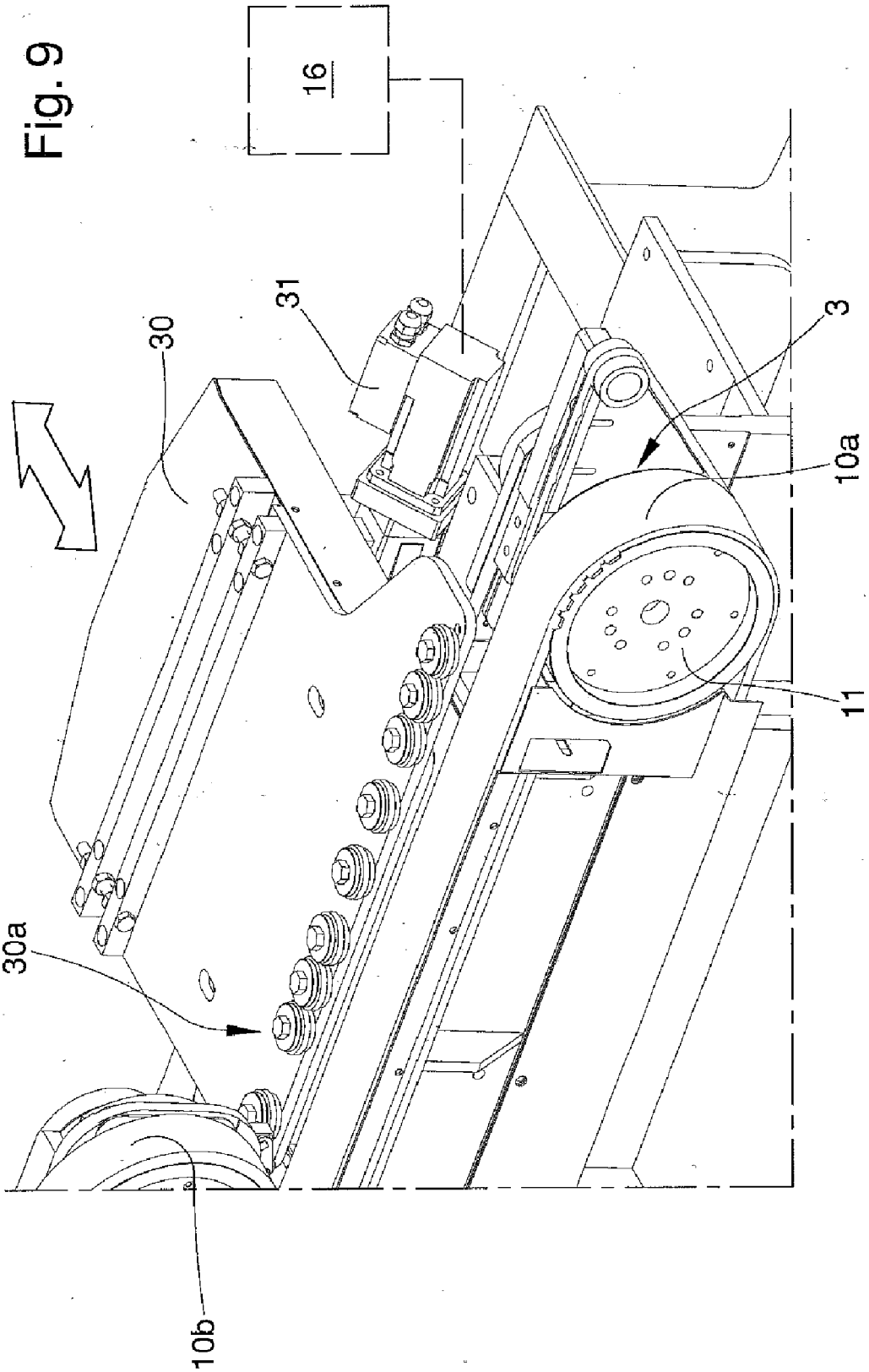


Fig. 7

Fig. 9



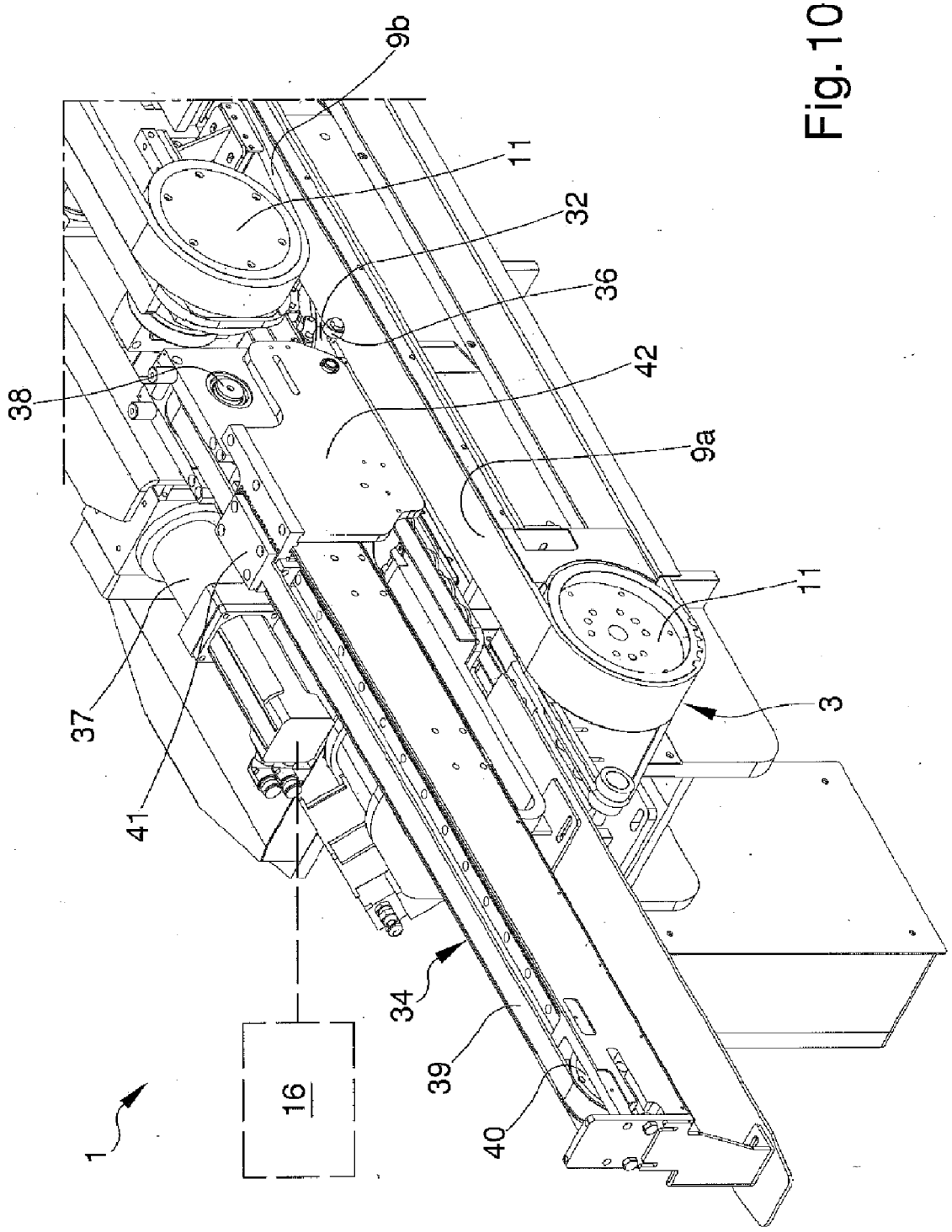
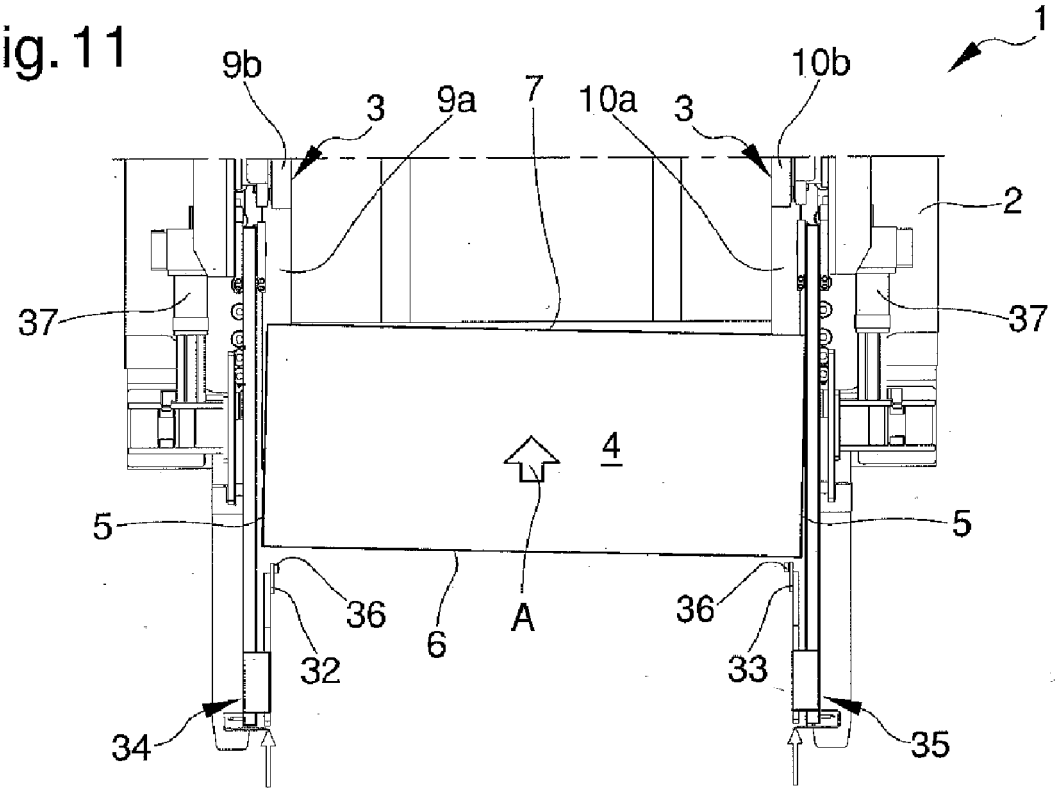


Fig. 10

Fig.11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9b
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9a
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A
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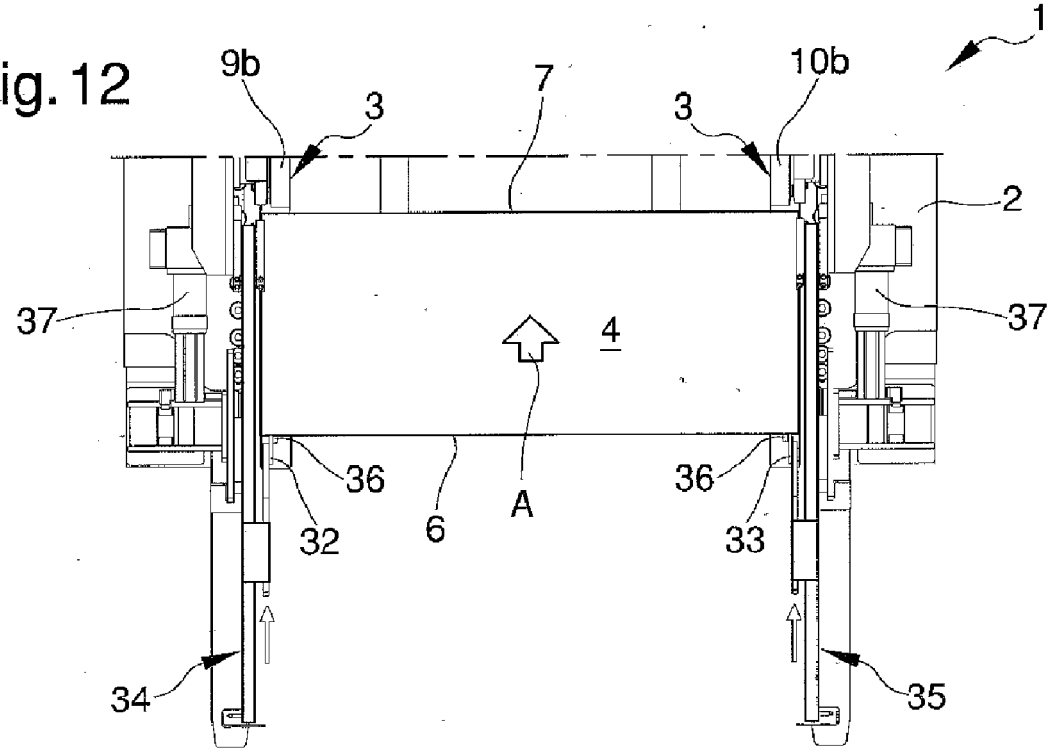
33
34
35

Fig.12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REFERENCES CITED IN THE DESCRIPTION

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