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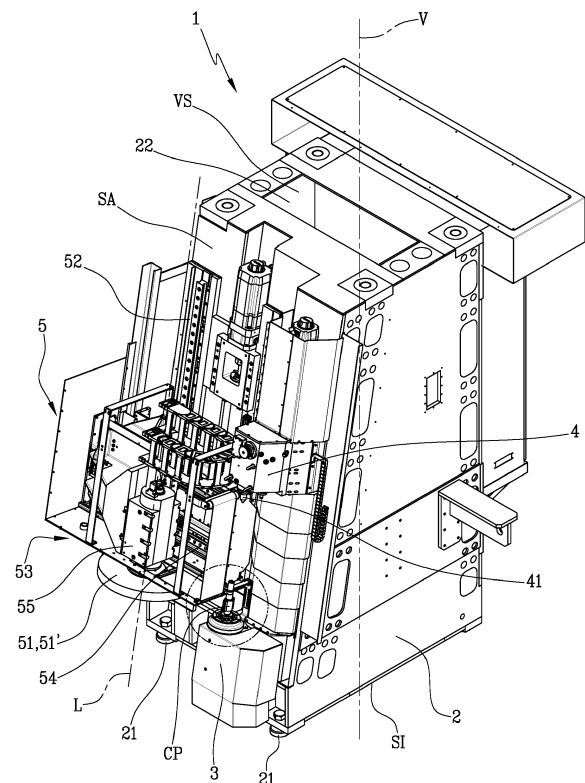
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(54) **AN APPARATUS FOR PERFORMING GRINDING OPERATIONS**

(57) An apparatus (1) for performing grinding operations on a component (CP) comprises: a base (2), configured to rest on a supporting surface on which the apparatus (1) is positioned; a part-holder spindle (3), configured to rotate about a longitudinal axis (A) and including a gripping element, to hold the component in place; a tailstock (4), aligned with the part-holder spindle (3) along the longitudinal axis (A) and movable towards and away from the spindle (3) for keeping the component, in use, between the part-holder spindle (3) and the tailstock (4) along the longitudinal axis (A); an operating unit (5), movable along an operating direction, parallel to the longitudinal axis (A), and along a transversal direction (T), perpendicular to the longitudinal axis (A). The operating unit (5) includes a first group of tools (51), configured to perform mechanical operations on the component. The longitudinal axis (A) is inclined, relative to a vertical axis (V) parallel to the direction of the weight force, by an angle of inclination (AC) of less than 90°.

Fig.1



Description

[0001] This invention relates to an apparatus for performing grinding operations on a component and to a method for performing grinding operations on a component.

[0002] Apparatuses for performing grinding operations known in the prior art can be broadly divided into two categories: horizontal-axis apparatuses and vertical-axis apparatuses. In a vertical-axis apparatus, the part is held between a part-holder spindle and a tailstock that is aligned with the part-holder spindle along a vertical axis. In a horizontal-axis apparatus, on the other hand, the part-holder spindle and the tailstock are aligned along a horizontal direction. Vertical-axis apparatuses have the advantage of having a much more reduced space requirement (smaller footprint) than horizontal-axis apparatuses. In a vertical-axis apparatus, on the other hand, the part is more difficult to position on the spindle because it needs to be held by a specific device while the spindle is tightened against the part in order to hold it in place.

[0003] Moreover, in the vertical-axis apparatuses known in the prior art, the part-holder spindle faces in the same direction as weight force. That means the tailstock is located lower down than the part-holder spindle. This type of configuration makes it even more difficult to position the part, which must be supported at the bottom, as well as the sides, and to synchronize the part, which must be rotated by a predetermined angle relative to the spindle. Vertical-axis apparatuses, therefore, are suitable mainly for production lines equipped with automatic loading devices, whilst they are very complex, if not impossible, to adapt to manual loading.

[0004] An example of a vertical-axis grinding machine is described in document US2013029567A.

[0005] The aim of this disclosure is to provide an apparatus and a method for performing grinding operations to overcome the above mentioned disadvantages of the prior art.

[0006] This aim is fully achieved by the apparatus and method of this disclosure as characterized in the appended claims.

[0007] According to an aspect of it, this disclosure provides an apparatus for performing grinding operations on a component.

[0008] The apparatus comprises a base, configured to rest on a supporting surface on which the machine is positioned.

[0009] The apparatus comprises a part-holder spindle, configured to rotate about a longitudinal axis. The part-holder spindle includes a gripping element to hold the component in place.

[0010] The apparatus comprises a tailstock. The tailstock is aligned with the part-holder spindle along the longitudinal axis. The tailstock is movable towards and away from the spindle to keep the component, in use, between the part-holder spindle and the tailstock along the longitudinal axis.

[0011] The apparatus comprises a working unit. The operating unit is movable along an operating direction, parallel to the longitudinal axis. The operating unit is movable along a transversal direction, perpendicular to the longitudinal axis. The operating unit includes a first group of tools, configured to perform mechanical operations on the component. According to an aspect of this disclosure, the longitudinal axis is inclined, relative to a vertical axis parallel to the direction of the weight force, by an angle of inclination of less than 90°.

[0012] It is noted that the inclination of the longitudinal axis is not a feature that depends on how the apparatus is positioned but is an intrinsic feature of the apparatus. In other words, the longitudinal axis is inclined, relative to a vertical axis parallel to the direction of the weight force, by an angle of inclination of less than 90° when the apparatus is placed on a horizontal surface perpendicular to the weight force.

[0013] In another formulation of this feature, it is noted that the base comprises an underside surface configured to be rested on a supporting surface, and the longitudinal axis is inclined with respect to an axis perpendicular to the underside surface by an angle of less than 90°. It is specified that the underside surface is not necessarily a real planar surface but may also be a virtual surface of the apparatus, defined by two or more supporting points or zones where the apparatus rests on the supporting surface. This configuration offers the advantages of an axis that is inclined with respect to the weight force and also of having a mass distribution suitable for this type of machining process, that is, suitable for preventing the machine from tipping over, where positioning a vertical machine in an inclined plane would give rise to a high risk of tipping over.

[0014] This feature allows providing a hybrid apparatus between a horizontal- and a vertical-axis apparatus, thereby lessening the respective disadvantages and retaining the respective advantages. In particular, reducing the footprint of the apparatus is combined with a step of positioning the part, where inclination plays an important role because it allows supporting the part on one side only, for example with one hand or with a support held by a user, whose hand remains outside the working zone (for safety reasons) while the part is being gripped by the part-holder spindle.

[0015] Preferably, the inclination angle is between 5° and 20°. In effect, this embodiment offers greater advantages in terms of ratio between machine footprint and component manageability during positioning.

[0016] Still more preferably, the inclination angle is between 8° and 12°. In effect, the trials carried out show that this inclination offers greater advantages in terms of minimizing the complications connected with the inclination of the longitudinal axis.

[0017] In an embodiment, the base comprises a hooking surface to which the operating unit, the part-holder spindle and the tailstock are connected. The hooking surface is inclined to the vertical axis by an angle of less

than 90°. The hooking surface faces in a direction which includes at least one component that is the opposite of the direction of the weight force. In other words, the direction of the normal directed outwards from the supporting surface includes at least one component that is the opposite of the direction of the weight force.

[0018] In an embodiment, the base comprises an inner cavity, defining a damping space, configured to damp the effects of the stress applied to the component during grinding operations.

[0019] In an embodiment, the hooking surface faces in a direction which includes at least one component that is the opposite of the direction of the weight force.

[0020] During positioning, this provides support, whether mechanical or manual, at the bottom, on the part-holder spindle itself, and at the side, as needed on account of the inclination.

[0021] In an embodiment, the part-holder spindle is positioned, along the longitudinal axis, downstream of the tailstock in the same direction as the weight force. In other words, the tailstock faces in a direction having at least one component that is the same as the direction of the weight force. In an embodiment, the operating unit comprises at least a second group of tools, positioned, relative to the first group of tools in an opposing configuration, that is to say, aligned with the first group of tools along a direction parallel to the longitudinal axis and opposite to the first group of tools on the same side of the part-holder spindle.

[0022] In an embodiment, the second group of tools is positioned in a parallel configuration, that is to say, aligned with the first group of tools along a transversal direction, perpendicular to the longitudinal axis, and positioned parallel to the first group of tools, on the opposite side of the part-holder spindle with respect to that where the first group of tools is positioned.

[0023] In an embodiment, the operating unit comprises a third group of tools. In this embodiment, the second group of tools is positioned in a parallel configuration relative to the first group of tools, while the third group of tools is positioned in an opposing configuration relative to the first group of tools or to the second group of tools.

[0024] Lastly, in an embodiment, the operating unit comprises a fourth group of tools. In this embodiment, the second group of tools is positioned in a parallel configuration relative to the first group of tools, the third group of tools is positioned in an opposing configuration relative to the first group of tools and the fourth group of tools is positioned in an opposing configuration relative to the second group of tools (hence in a parallel configuration relative to the third group of tools).

[0025] These configurations progressively increase the production capabilities of the machine and further enhance its performance.

[0026] In an embodiment, the first group of tools comprises a straight grinding wheel, rotating about an axis of rotation parallel to the longitudinal axis.

[0027] In an embodiment, the first group of tools com-

prises an inclinable grinding wheel, where the axis of rotation of the grinding wheel is adjustable and inclinable relative to the longitudinal axis.

[0028] In an embodiment, the first group of tools comprises a turning unit, for performing turning operations on the component.

[0029] It should be noted that the second group of tools, the third group of tools and the fourth group of tools may include one or more of the aforesaid tools, which could potentially be integrated in the first group of tools, that is to say, the straight grinding wheel, the inclinable grinding wheel and the turning unit.

[0030] According to an aspect of this description, the apparatus comprises a supporting device, associated with the part-holder spindle. The supporting device is configured to supportably receive the component to be gripped. The supporting device is positioned on the side of the part-holder spindle on which the component would fall on account of the inclination of the longitudinal axis.

[0031] Thus, the part can be rested on the supporting device and on the part-holder spindle, making its positioning very easy and safe.

[0032] In an embodiment, the supporting device comprises a transversal rod, elongate along a supporting axis, perpendicular to the longitudinal axis between a first end and a second end. The supporting device also comprises a supporting profile, located at the second end of the transversal rod. The supporting profile is concave to supportably receive the component. For example, the supporting profile is a semicircle or a U-shaped profile or a V-shaped profile.

[0033] In an embodiment, the length of the transversal rod along the supporting axis is variable between a first limit length and a second limit length.

[0034] That way, the supporting profile can be positioned at a distance from the longitudinal axis that is variable and can be adapted to the diameter of the part being machined. Thus, depending on the part to be machined, an operator using the machine manually can first adapt the length of the transversal rod based on the diameter of the component and then set the component down before the part-holder spindle grips it.

[0035] In an example embodiment, the supporting device comprises a longitudinal rod, elongate along a direction parallel to the longitudinal axis between a first end, connected to the part-holder spindle, and a second end, connected to the transversal rod.

[0036] Preferably, the longitudinal length of the transversal rod is variable between a first longitudinal limit length and a second longitudinal limit length. This allows adapting the supporting device also to the length of the component along the longitudinal axis, to allow the component to be set down at a middle position, ensuring it remains in place (and does not turn about the point of contact between the component and the supporting profile).

[0037] According to an aspect of it, this disclosure provides a method for performing grinding operations on a

component.

[0038] The method comprises a step of resting on a supporting surface a base of the machine for performing grinding operations.

[0039] The method comprises a step of holding the component by means of a part-holder spindle.

[0040] The method comprises a step of rotating the component by rotation of the part-holder spindle about a longitudinal axis.

[0041] The method comprises a step of moving a tailstock of the machine towards and away from the spindle, to lock the component between the spindle and the tailstock.

[0042] The method comprises a step of shifting an operating unit along an operating direction, parallel to the longitudinal axis.

[0043] The method comprises a step of performing mechanical operations on the component using the operating unit.

[0044] Advantageously, during the rotation step, the longitudinal axis is oriented in an inclined fashion, relative to a vertical axis parallel to the direction of the weight force, by an angle of inclination of less than 90°, preferably between 5° and 25°, and still more preferably, between 8° and 12°.

[0045] This and other features will become more apparent from the following description of a preferred embodiment, illustrated purely by way of non-limiting example in the accompanying drawings, in which:

- Figure 1 shows a perspective view of an apparatus for performing grinding operations according to this disclosure;
- Figure 2 shows a perspective view of a detail of the apparatus of Figure 1;
- Figure 3 shows a side view of the apparatus of Figure 1;
- Figure 4 schematically illustrates an embodiment of the apparatus of Figure 1.

[0046] With reference to the accompanying drawings, the reference numeral 1 denotes an apparatus for performing grinding operations on a component CP. It should be noted that in an embodiment, the apparatus 1 is also configured to perform turning operations on the component CP.

[0047] The apparatus 1 comprises a base 2, configured to support the apparatus 1 on a supporting surface on which the apparatus 1 is positioned.

[0048] The base 2 comprises an underside surface SI, resting on the supporting surface. The base 2 comprises a plurality of supporting feet 21, interposed between the underside surface SI and the supporting surface. In an embodiment, the plurality of supporting feet 21 has a length which, along a vertical direction V, parallel to the direction of the weight force, is adjustable to allow the apparatus 1 to be placed even on supporting surfaces that are not entirely flat but have some irregular features

on them. The base includes a hooking surface SA.

[0049] The base 2 comprises an inner cavity 22, defining a damping space VS. The apparatus 1 comprises a part-holder spindle 3, configured to grip and hold the component CP in place. The spindle 3 rotates about a longitudinal axis A. The spindle 3 includes a gripping element 31 to hold the component CP in place. In addition or alternatively, the spindle may comprise a headstock. The gripping element 31 preferably has a circular shape and includes an opening or a headstock in or on which the component CP is positioned. The spindle 3 comprises a fixed surface 32, fixed relative to the base 2, hence non-rotating about the longitudinal axis A.

[0050] The apparatus 1 comprises a tailstock 4. The tailstock 4 is aligned with the spindle 3 along the longitudinal axis A. The tailstock 4 comprises a contact element 41 (preferably a headstock 41) which is configured to contact the component CP from a side opposite to that of the spindle 3. In use, therefore, the component CP is interposed, along the longitudinal axis A, between the spindle 3 and the tailstock 4.

[0051] The tailstock 4 is movable towards and away from the spindle 3. In effect, the tailstock 4 is slidable in a tailstock guide 42 along the longitudinal axis A.

[0052] The apparatus 1 comprises an operating unit 5. The operating unit 5 includes at least one tool 51 (or a first group of tools 51), configured to perform mechanical operations on the component CP, specifically grinding and/or turning operations.

[0053] The operating unit 5 is movable along an operating direction L, parallel to the longitudinal axis A. In addition or alternatively, the operating unit 5 is movable along a transversal direction, perpendicular to the longitudinal axis A, towards or away from the component CP held by the spindle 3.

[0054] The apparatus 1 comprises a first guide 52.

[0055] The apparatus comprises a carriage 53.

[0056] The apparatus comprises a second guide 54, formed on the carriage 53.

[0057] In an embodiment, the carriage 53 is slidable on the first guide 52 along an operating direction L. The operating unit 5 is connected to the second guide 54. Thus, the operating unit 5 is movable along the operating direction L under the action of the carriage 53 moving along the first guide 52.

[0058] The operating unit 5 is movable on the second guide 54 along the transversal direction T.

[0059] The operating unit 5 comprises a rotary actuator 55, which, by way of non-limiting example, may be a grinding wheel spindle or a tool turret, configured to set the at least one tool 51 or the first group of tools 51 in rotation.

[0060] It should be noted that the first tool 51 is, by way of a non-limiting example, a straight grinding wheel 51', as illustrated in Figure 1.

[0061] The operating unit 5 is connected to the hooking surface SA of the base 2 by means of the first guide 52. The spindle 3 is connected to the hooking surface SA of

the base 2. The tailstock 4 is connected to the hooking surface SA of the base 2.

[0062] More specifically, the first guide 52 and the tailstock guide 42 are connected to the hooking surface SA of the base 2. Thus, the tailstock 4 and the operating unit 5 move along the hooking surface SA of the base 2 on the respective tailstock guide 42 and first guide 52.

[0063] The longitudinal axis A is inclined, relative to a vertical axis V parallel to the direction of the weight force, by an angle of inclination AC of less than 90°, preferably between 5° and 20°, and still more preferably, between 8° and 12°.

[0064] The hooking surface SA is inclined, relative to the vertical axis V, by an angle of less than 90°, preferably between 5° and 20°, and still more preferably, between 8° and 12°. The hooking surface faces in a direction VS which includes at least one component that is the opposite of the direction of the weight force.

[0065] It should be noted that in the apparatus 1 illustrated in Figure 1, the position of the tailstock 4 relative to the spindle 3 is particularly advantageous for positioning the component CP. More specifically, the part-holder spindle 3 is positioned, along the longitudinal axis A, downstream of the tailstock 4 in the same direction as the weight force. In other words, the spindle 3 is positioned under the tailstock 4.

[0066] According to an aspect of this disclosure, the apparatus 1 comprises a supporting device 6. Described below is an exemplary, non-limiting embodiment of the supporting device 6.

[0067] The supporting device 6 is configured to supportably receive the component CP during the step of positioning and gripping the component CP by the gripping element 31 of the spindle 3.

[0068] The supporting device 6 is positioned on the side of the spindle 3 on which the component CP would fall on account of the inclination of the longitudinal axis A (that is to say, on account of the weight force). The supporting device 6 is thus interposed, along a direction perpendicular to the longitudinal axis A, between the hooking surface SA of the base 2 and the longitudinal axis A.

[0069] The supporting device comprises a supporting profile 61 configured to supportably receive the component CP. The supporting profile 61 is a concave profile adapted to securely receive the component CP to be gripped in its concavity.

[0070] The supporting device 6 comprises a transversal rod 62. The device comprises a longitudinal rod 63.

[0071] The transversal rod 62 extends along an adjustment direction R, perpendicular to the longitudinal axis A, between a first end 62A and a second end 62B. The supporting profile 61 is formed on the second end 62B of the transversal rod 62. At its first end 62A, the transversal rod 62 comprises a first slot 621 (or a first group of slots). The first slot 621 extends along the transversal direction for a length that defines a stroke along which the transversal rod 62 can move in the transversal direc-

tion. In other words, the transversal rod 62 has a length along the adjustment direction R that is variable (adjustable) between a first limit position and a second limit position. The distance along the adjustment direction R between the first limit position and the second limit position is equal to the length of the first slot 621 along the adjustment direction R.

[0072] The longitudinal rod 63 extends along a direction parallel to the longitudinal axis A, between a first end 63A and a second end 63B. The longitudinal rod 63 comprises a fixed element 631 and a movable element 632 which are removably connected to each other to adjust a length of the longitudinal rod along a direction parallel to the longitudinal axis A.

[0073] More specifically, the movable element 632 comprises a second slot and a third slot 632', located on opposite ends of the movable element 632. The second slot is configured to be connected to the first slot 621 of the transversal rod 62, for example, by threaded means familiar to a person skilled in the art.

[0074] The fixed element 631 extends along a direction parallel to the longitudinal axis A between a first end 631A, which is fixedly connected to the fixed surface 32 of the spindle 3, and a second end, which has, formed on it, a fourth slot, configured to be connected to the third slot 632', for example, by threaded means familiar to a person skilled in the art.

[0075] It should be noted that the length of the third slot 632' (or of the fourth slot) defines the maximum stroke of the longitudinal rod 63 along a direction parallel to the longitudinal axis A. In other words, the length of the longitudinal rod 63 may vary by a longitudinal length equal to the length of the third slot 632' (or of the fourth slot).

[0076] In an embodiment, illustrated schematically in Figure 4, the operating unit 5 comprises a second tool 56 (or a second group of tools 56). The second tool comprises a dedicated rotary actuator, which allows moving, that is to say, rotating, the second tool 56.

[0077] For example, the operating unit 5 comprises a second carriage 56', to which the second tool 56 is removably connected. In other words, the second tool 56 is movable along the transversal direction T on the carriage.

[0078] In an embodiment, the first tool 51 and the second tool 56 are positioned on opposite sides of the longitudinal axis A along the transversal direction T. In this embodiment, the operating unit comprises a third guide 52', parallel to the first guide 52. In this case, the second carriage 56' runs on the third guide 52' to move along the operating direction L on the side opposite to that where the first guide 52 is positioned.

[0079] In an embodiment, the second tool 56 is aligned with the first tool 51 along the operating direction L. In such a case, therefore, the first tool 51 and the second tool 56 are positioned on the same side of the longitudinal axis A at different longitudinal heights. Thus, both the first carriage 53 and the second carriage 56 run on the first guide 52.

[0080] In an embodiment, the second tool 51 is movable along the operating direction L and/or along the transversal direction T independently of the second tool 56.

[0081] In an embodiment, the operating unit 5 comprises a third tool 57 (or a third group of tools 57). The third tool 57 comprises a dedicated rotary actuator, which allows moving, that is to say, rotating, the third tool 57.

[0082] In such a case, the operating unit 5 comprises a third carriage 57', to which the third tool 57 is removably connected. In other words, the third tool 57 is movable along the transversal direction T on the third carriage 57'.

[0083] In an embodiment, the first tool 51 and the third tool 57 are positioned on opposite sides of the longitudinal axis A along the transversal direction T. In this embodiment, the third carriage 57' runs on the third guide 52' to move along the operating direction L on the side opposite to that where the first guide 52 is positioned. In such a case, the second carriage 56' can run on the first guide 52 or on the third guide 52' to move along the same guide as the first tool 51 or the third tool 56.

[0084] In an embodiment, the third tool 56 is aligned with the first tool 51 along the operating direction L. In such a case, therefore, the first tool 51 and the third tool 57 are positioned on the same side of the longitudinal axis A at different longitudinal heights. Thus, both the first carriage 53 and the third carriage 57 run on the first guide 52.

[0085] In this case, the second carriage 56' runs on the third guide 53'.

[0086] In an embodiment, the first tool 51 is movable along the operating direction L and/or along the transversal direction T independently of the second tool 56 and/or of the third tool 57.

[0087] Lastly, the operating unit may comprise a fourth tool 58 (or a fourth group of tools 58). The fourth tool 58 comprises a dedicated rotary actuator, which allows moving, that is to say, rotating, the fourth tool 58.

[0088] In such a case, the operating unit 5 comprises a fourth carriage 58', to which the fourth tool 58 is removably connected. In other words, the third tool 58 is movable along the transversal direction T on the third carriage 58'.

[0089] In an embodiment, the first tool 51 and the fourth tool 57 are positioned on opposite sides of the longitudinal axis A along the transversal direction T, hence the second tool and the third tool are also positioned on opposite sides of the longitudinal axis A along the transversal direction T. In this embodiment, the fourth carriage 58' runs on the third guide 52' to move along the operating direction L on the side opposite to that where the first guide 52 is positioned.

[0090] In an embodiment, the fourth tool 58 is aligned with the first tool 51 along the operating direction L, hence the second tool 56 and the third tool 57 are aligned along the operating direction but on the opposite side, that is, they are both connected to the third guide 52'.

[0091] In this case, the fourth carriage 58' runs on the

first guide 52.

[0092] In an embodiment, the first tool 51 is movable along the operating direction L and/or along the transversal direction T independently of the second tool 56 and/or of the third tool 57 and/or of the fourth tool.

[0093] It should be noted that irrespective of the number of tools included in the operating unit 5, when there are two tools aligned along the operating direction L and which thus run on the same guide (the first guide 52 or the third guide 52'), these tools face each other, hence are disposed opposite one another.

[0094] The first, second, third and/or fourth tool 51, 56, 57, 58 (that is, the first group of tools 51, the second group of tools 56, the third group of tools 57 and the fourth group of tools 58) include one or more of the following features:

- a straight grinding wheel 51', rotating about an axis of rotation parallel to the longitudinal axis A;
- an inclinable grinding wheel 511, 561, 571, 572, where the axis of rotation of the grinding wheel is adjustable and inclinable relative to the longitudinal axis A;
- a turning unit, for performing turning operations on the component.

Claims

1. An apparatus (1) for performing grinding operations on a component (CP), comprising:
 - a base (2), configured to rest on a supporting surface on which the apparatus (1) is positioned;
 - a part-holder spindle (3), configured to rotate about a longitudinal axis (A) and including a gripping element, to hold the component in place;
 - a tailstock (4), aligned with the part-holder spindle (3) along the longitudinal axis (A) and movable towards and away from the spindle (3) for keeping the component, in use, between the part-holder spindle (3) and the tailstock (4) along the longitudinal axis (A);
 - an operating unit (5), movable along an operating direction, parallel to the longitudinal axis (A), and along a transversal direction (T), perpendicular to the longitudinal axis (A), the operating unit (5) including a first group of tools (51), configured to perform mechanical operations on the component,

characterized in that the longitudinal axis (A) is inclined, relative to a vertical axis (V) parallel to the direction of the weight force, by an angle of inclination (AC) of less than 90°.
2. The apparatus (1) according to claim 1, wherein the angle of inclination (AC) is between 5° and 20°.

3. The apparatus (1) according to claim 2, wherein the angle of inclination (AC) is between 8° and 12°.
4. The apparatus (1) according to any one of the preceding claims, wherein the base (2) comprises a hooking surface (SA), on which the operating unit (5), the part-holder spindle (3) and the tailstock (4) are connected, wherein the hooking surface (SA) is inclined relative to the vertical axis (V) by an angle of less than 90° and wherein the hooking surface (SA) faces in a direction which includes at least one component that is the opposite of the direction of the weight force.
5. The apparatus (1) according to any one of the preceding claims, wherein the base (2) comprises an inner cavity (22), defining a damping space (VS).
6. The apparatus (1) according to any one of the preceding claims, wherein the part-holder spindle (3) is positioned, along the longitudinal axis (A), downstream of the tailstock (4) in the same direction as the weight force.
7. The apparatus (1) according to any one of the preceding claims, wherein the operating unit (5) comprises at least a second group of tools (56), positioned, relative to the first group of tools (51), in one of the following configurations:
 - aligned along a direction parallel to the longitudinal axis (A) and opposite the first group of tools (51), on the same side of the part-holder spindle (3);
 - aligned along a transversal direction (T), perpendicular to the longitudinal axis (A), and positioned parallel to the first group of tools (51), on an opposite side of the part-holder spindle (3) with respect to that in which the first group of tools (51) is positioned.
8. The apparatus (1) according to any one of the preceding claims, wherein the first group of tools (51) comprises one or more of the following components:
 - a straight grinding wheel, rotating about an axis of rotation parallel to the longitudinal axis (A);
 - an inclinable grinding wheel, wherein the axis of rotation of the grinding wheel is adjustable and inclinable relative to the longitudinal axis (A);
 - a turning unit, for performing turning operations on the component.
9. The apparatus according to any one of the preceding claims, comprising a supporting device (6), associated with the part-holder spindle (3) and configured to supportably receive the component to be gripped and wherein the supporting device (6) comprises:
 - a transversal rod (62), elongate along a supporting axis, perpendicular to the longitudinal axis (A) between a first end (62A) and a second end (62B);
 - a supporting profile (61), located at the second end (62A) of the transversal rod (62) and concave, to supportably receive the component (CP).
10. The apparatus according to claim 9, wherein the length of the transversal rod (62) along the supporting axis is variable between a first limit length and a second limit length.
11. The apparatus according to claim 9 or 10, wherein the supporting device (6) comprises a longitudinal rod (63), elongate along a direction parallel to the longitudinal axis (A) between a first end (63A), connected to the part-holder spindle (3), and a second end (63B), connected to the transversal rod (62) and wherein the longitudinal length of the transversal rod (63) is variable between a first longitudinal limit length and a second longitudinal limit length.
12. The apparatus according to any one of the preceding claims, wherein the base (2) comprises an underside surface (SI) configured to be rested on the supporting surface, and wherein the longitudinal axis (A) is inclined with respect to an axis perpendicular to the underside surface (SI) by an angle of less than 90°.
13. A method for performing grinding operations on a component (CP), the method including the following steps:
 - resting on a supporting surface a base (2) of the machine (1) for performing grinding operations;
 - holding the component by means of a part-holder spindle (3);
 - rotating the component by rotation of the part-holder spindle (3) about a longitudinal axis (A);
 - moving a tailstock (4) of the machine (1) towards and away from the spindle (3), to lock the component between the spindle (3) and the tailstock (4);
 - shifting an operating unit (5) along an operating direction, parallel to the longitudinal axis (A);
 - performing mechanical operations on the component using the operating unit (5),

characterized in that, during the rotation step, the longitudinal axis (A) is oriented in an inclined fashion, relative to a vertical axis (V) parallel to the direction of the weight force, by an angle of inclination (AC) of less than 90°.

Fig.1

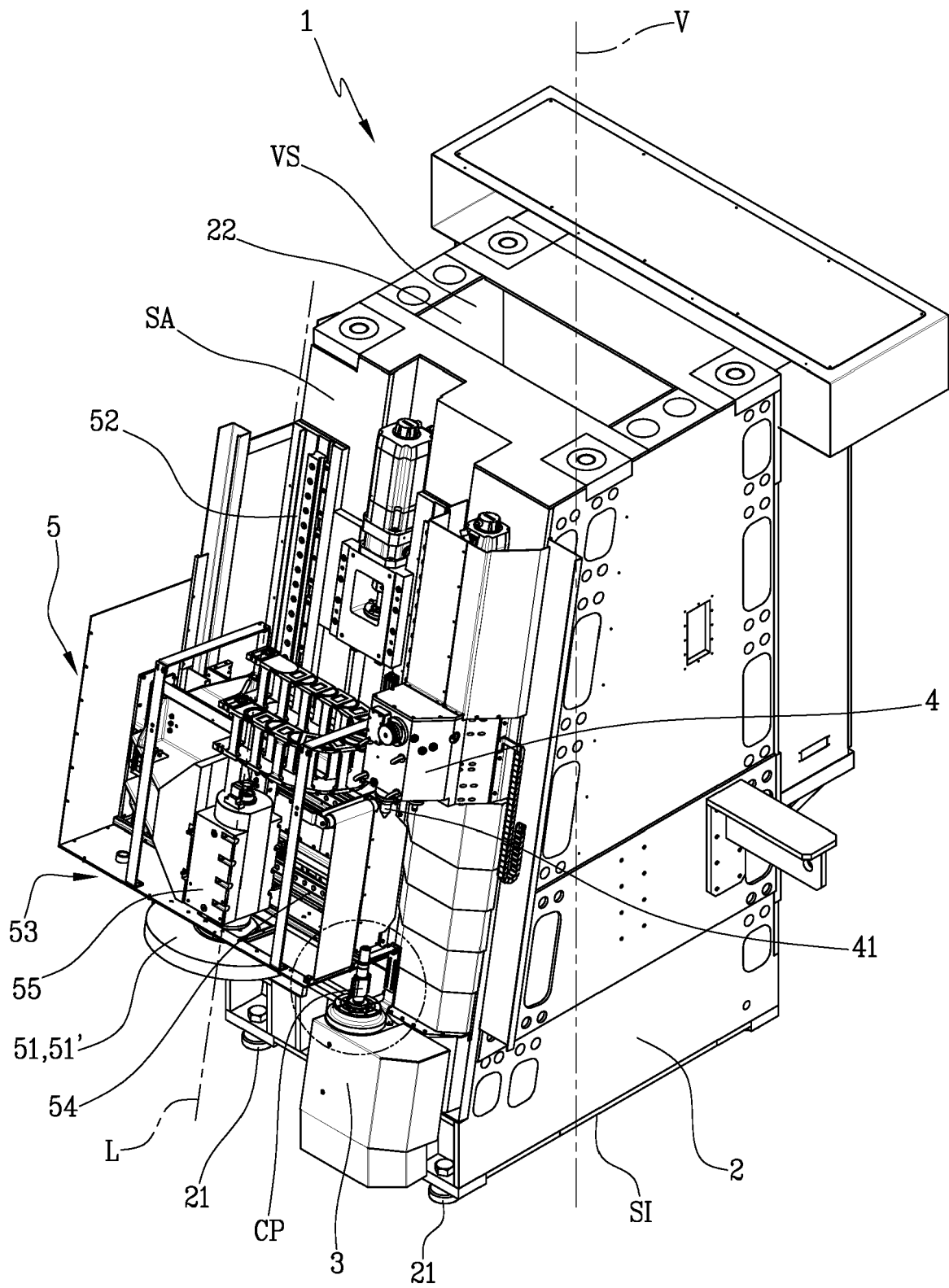


Fig.2

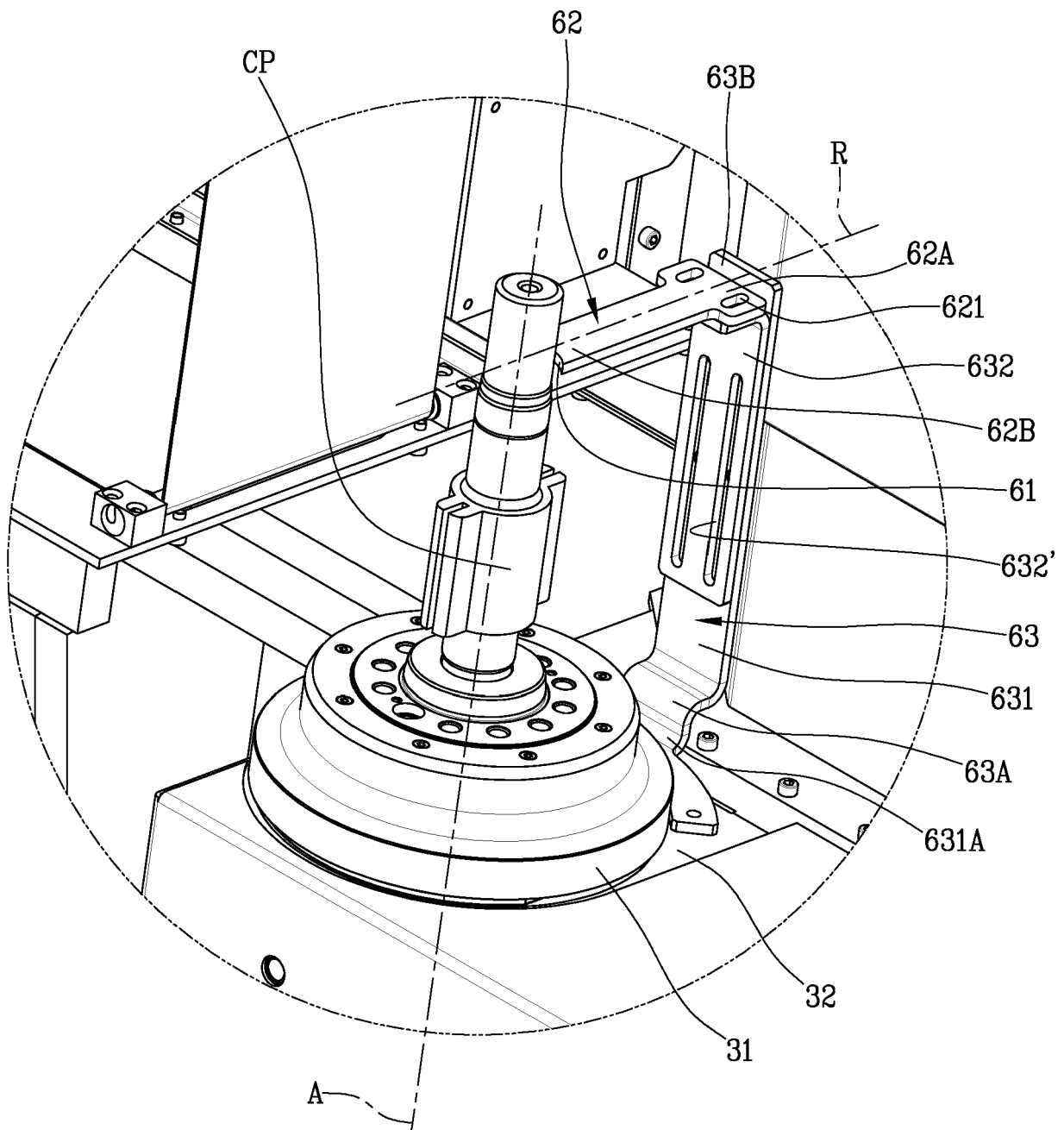


Fig.3

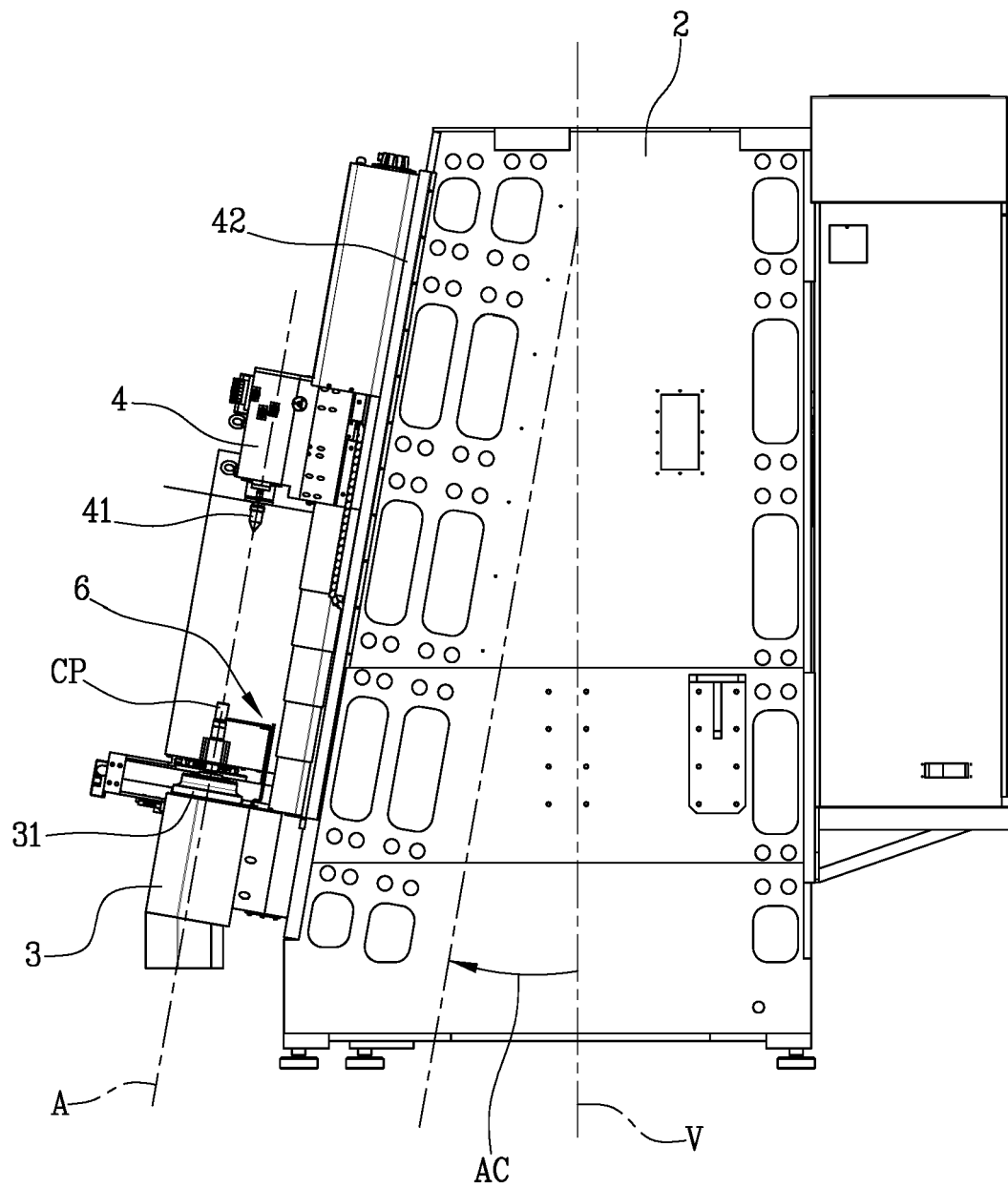
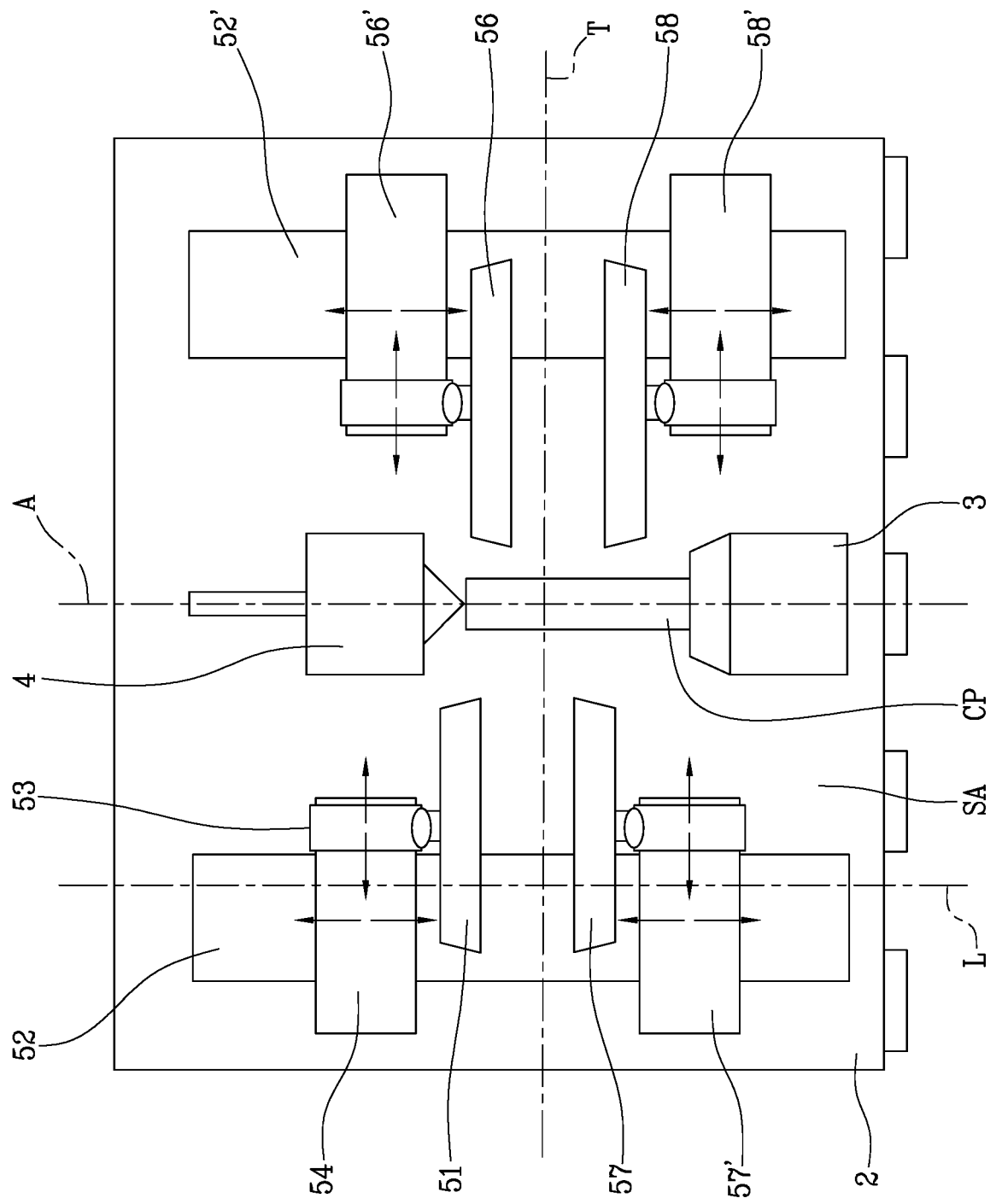


Fig. 4





EUROPEAN SEARCH REPORT

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			TECHNICAL FIELDS SEARCHED (IPC)
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Place of search Munich		Date of completion of the search 24 January 2023	Examiner Herrero Ramos, J
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