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SANDING MACHINE FOR MACHINING WORKPIECES

- (57) The present invention refers to a machine (M) for machining workpieces (P), comprising a frame (T), a device for transporting workpieces (P) to be machined along a first direction (i), an operating unit for machining the workpieces (P), said unit including a first roller (1) and a second roller (2), rotating around an axis oriented along a second direction (j) transversal to the first direction (i), and configured to support and move a belt for machining workpieces (P), a crossbar (21) supporting said first (1) and second (2) rollers, wherein the crossbar (21) is rigidly fixed to the frame (T) of said machine (T),

and wherein the first roller (1) is coupled to said crossbar (21) so as to rotate around a third direction (k) transversal to the first (i) and the second direction (j). Said machine (M) comprising an actuator (3) coupled to said frame (T) and to said first roller (1), so as to rotate, when actuated, the first roller (1) around said third direction (k). Said machine (M) furthermore comprises a damping device (5; 6) coupled to said frame (T) and to the first roller (1), and configured to limit the movement of the first roller (1) around the third direction (k) within a predetermined range.

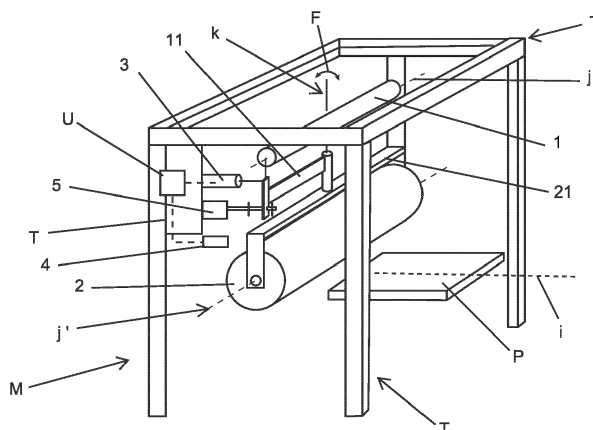


Fig. 2

Description

[0001] The present invention concerns a sanding machine for machining workpieces, for example pieces made of metal, wood or composite material.

Field of invention

[0002] In more detail, the invention concerns a pass sanding machine, or even a satin or deburring machine, for machining the surface of pieces using an abrasive belt circulating on at least two rotating rollers.

[0003] In particular, the invention concerns a machine equipped with a device for adjusting the position of the belt on the rollers.

[0004] In the following the description will be addressed to a sanding machine comprising a sanding roller for the machining of pieces made of metal, wood or composite material, but it is clear that it should not be considered limited to this specific use.

Prior Art

[0005] As is well known, sanding machines for machining the surface of pieces are currently known, comprising one or more conveyor belts for transporting the panels to be machined and one or more working units arranged above and/or below said conveyor belts for sanding the upper and/or the lower face of the pieces facing the working unit.

[0006] Each working unit includes at least one lower operating roller, called the driving or driving roller, and one upper idle roller, called the driven roller, oriented along directions substantially parallel to each other and arranged at a variable distance in such a way as to define a tension value of an abrasive belt mounted between them.

[0007] The rollers rotate about their axis in a concordant direction or in opposition to the advancement direction of the panel being machined, so as to circulate the belt and machine the surface of the panel when it is passed near the operating roller, contacting the abrasive face of the belt itself.

[0008] Currently, the abrasive belts used in these machines are made by cutting large rolls of belt into shorter lengths.

[0009] Two opposite sides of the section are joined, for example by gluing, to form a belt to be positioned around the rollers, as shown in figure 1A relating to the prior art.

[0010] The rollers are spaced so as to impose sufficient tension on the belt itself so that it can be moved by the rotation of the rollers.

[0011] Ideally, the two edges L1, L2 of the belt should be of equal length, so that the belt, when tensioned between the rollers, becomes a cylindrical surface.

[0012] In reality, the operation of joining the opposite sides of the belt sections, however precise, is never free

from errors, even minimal ones.

[0013] The result is that the edges L1, L2 of the belt have different lengths, and the tensioning of the same determines a truncated-cone shape.

[0014] Currently, known sanding machines require the orientation of the driven roller in space to be variable, so as to accommodate the deformations of the belt and to be able to tension it appropriately.

[0015] With reference to the figures 1B and 1C, the driven roller RC can in fact rotate around an axis coinciding with the advancement direction I of a piece P in the machine, to overcome the described problem.

[0016] However, when the belt is circulated, its state of tension, together with the dragging movement of the rollers, generates different values of tension force to which each edge is subjected to.

[0017] This tension difference induces a translational movement of the belt along the surface of the rollers, in the direction corresponding to their rotation axis J, which, if not controlled, causes the belt itself to escape from its natural seat on the rollers.

[0018] This problem is overcome, in a known way, by modifying the orientation of the driven roller RC around an axis K, which is transversal both with respect to the advancement direction I and with respect to the rotation axis J of the roller itself, as indicated by the double arrows F in figures 1B and 1C.

[0019] The rotation of the roller generates a different deformation condition in the edges of the belt compared to that in which they are initially positioned on the rollers.

[0020] The tension state of the edges changes accordingly, and induces a translation of the strip in the opposite direction compared to that caused by the previous tension state.

[0021] The rotation of the roller RC around the K axis is obtained by an actuator and by a support (not shown), arranged in a central position with respect to the driven roller RC (Fig. 1B), or arranged at an end E of the driven roller RC (Fig. 1C), and on which the roller RC is hinged.

[0022] In addition, the use of one or more positioning sensors (not shown) of the belt and a control unit is envisaged, which receives the signals from the sensors and commands the activation of the actuator, so as to cause a rotation of the roller in one or the other direction around the K axis, depending on whether a translation must be induced in the belt towards one or the other direction with respect to the J axis.

[0023] The rotation of the roller, therefore, alternates in one direction or the other depending on the position of the belt measured by the sensors.

[0024] Operationally, when an edge of the belt approaches one end of the roller RC, exceeding a certain threshold, the sensor detects its movement and sends a signal to the control unit, which, through the movement of the actuator, rotates the roller itself around the K axis.

[0025] In practice, the rotation of the roller is limited due to some intrinsic constraints in the operation of the machine.

[0026] During machining, in fact, the belt is made very unstable due to the rather high circulation speeds that it can reach when moved by the rollers.

[0027] Consequently, if subjected to sudden movements or stresses or stresses beyond a certain limit, the belt may undergo oscillations and/or movements that are impossible to control in a time short enough to prevent it from coming off the rollers.

[0028] For this reason, the rotation of the driven roller around the K axis, and, therefore, the stroke excursion of the actuator, must be limited to a certain length interval.

[0029] This interval is identified around an equilibrium position, which depends on the characteristics of each belt.

[0030] Potentially, the stroke could be limited electronically through the use of actuators or linear motors, the movement of which can be controlled at will.

[0031] For economic reasons, however, the prior art makes use of pneumatic actuators, which have the technical limitation of being able to assume only two positions, corresponding to the minimum or maximum strokes of the piston in the chamber.

[0032] An adjustment operation of the stroke positioning takes place manually when the belt is installed in the machine, by specialized and expert technical personnel.

[0033] The operator, using a process of trial and error and his/her own experience, initially identifies the "natural" or initial equilibrium position of the belt on the rollers.

[0034] Subsequently, adjust the mechanical elements responsible for limiting the stroke of the actuator so as to contain its movement within a range, smaller than the maximum possible stroke.

[0035] This operation must be repeated when a belt is replaced or based on the behavior of the same belt during use, which may vary due to environmental conditions (e.g., humidity) or use (e.g., wear, deformation).

[0036] Furthermore, it is a time-consuming and economical operation, as it requires the machine to be stopped.

Purpose of the invention

[0037] Therefore, in light of the above, an aim of the present invention is to provide a sanding machine for machining parts that overcomes the drawbacks of the prior art.

[0038] A further purpose of the invention is to provide a machine of the above type capable of machining parts, reducing production costs and times, and which is at the same time easy to use.

[0039] Another purpose of the invention is to provide a machine of the type mentioned which requires limited maintenance or adjustment of its components compared to machines of the prior art.

[0040] Finally, the aim of the invention is to provide a solution to the drawbacks described above that is easy and economical to implement in existing sanding machines, in place of the advantages achieved.

Object of the invention

[0041] It is, therefore, specific object of the present invention a machine, for machining workpieces, comprising a frame, device for transporting workpieces, to be machined along a first direction, operating unit for machining the workpieces, said unit including a first roller and a second roller, rotating around an axis oriented along a second direction, transversal to the first direction, and configured to support and move a belt for machining workpieces, a crossbar supporting said first and second rollers, wherein the crossbar is rigidly fixed to the frame, of said machine, and wherein the first roller is coupled to said crossbar so as to rotate around a third direction transversal to the first and the second direction, said machine, comprising an actuator coupled to said frame, and to said first roller, so as to rotate, when actuated, the first roller around said third direction, and further comprising a damping device coupled to said frame, and to the first roller, and configured to limit the movement of the first roller around the third direction within a predetermined range.

[0042] Further, the machine may comprise a sensor and a control logic unit operatively connected to the actuator and to the sensor, wherein the sensor is configured to send to the control logic unit a signal associated with the position with respect to the axis of a belt running on the first and/or on the second roller, and wherein the control logic unit is configured to operate the actuator and rotate the first roller around the third direction, to maintain a circulating belt in a predetermined equilibrium position with respect to the axis of the first and/or of the second roller.

[0043] Optionally, said damping device may be configured so that the position of said predetermined interval with respect to the frame of the machine is variable.

[0044] Further, the machine may comprise a support coupled to the first roller, rotatably coupled to said crossbar, and slidingly coupled to said stem, and the damping device may comprise a first abutment element and a second abutment element for the support, which define said predetermined interval of movement of the first roller around the third direction.

[0045] In addition, the first roller may rotate around the third direction between a first position, in which the support is located near the first abutment element, and a second position, wherein the support is located close to the second abutment element.

[0046] In one embodiment, the damping device may comprise at least one chamber containing a fluid, a piston slidably constrained in said chamber, and a stem, wherein the first roller is configured to abut with at least a portion of said stem.

[0047] In one embodiment, the machine may comprise a support coupled to the first roller, rotatably coupled to said crossbar and slidingly coupled to said stem, and the damping device may comprise a chamber, a double-acting piston, slidably constrained in said chamber, and a

stem comprising a first portion and a second portion arranged on opposite faces of the piston, wherein the chamber of the actuator and the chamber of the damping device are rigidly coupled to the support, and wherein the first and second portions of the stem of the damping device face respective portions of the frame of the machine, and define said predetermined range of movement of the first roll around the third direction.

[0048] The piston may comprise a through hole for the leakage of said fluid.

[0049] In one embodiment, the damping device may comprise a first shock absorber comprising a first piston sliding so as to define a first chamber and a second chamber, both containing a fluid, and equipped with a first stem, a second shock absorber comprising a second piston, sliding so as to define a respective first chamber and a respective second chamber both containing a fluid, and equipped with a second stem, wherein the first chambers and the second chambers are respectively in fluid communication by first and second channels, and wherein the first and second stem face the support and respectively comprise the first and second abutment element for the support.

[0050] Finally, the machine may comprise a blocking device comprising a slide, rigidly fixed to the support, and a slider, slidably connected to the slide, and comprising a first end and a second end, each one in contact with a respective portion of the frame of the machine, and wherein the slider position with respect to the slide is reversibly blockable, so that said predetermined range of movement of the first roller around the third direction is fixed.

Brief description of the figures

[0051] The present invention will be now described, for illustrative but not limitative purposes, according to its preferred embodiments, with particular reference to the figures of the enclosed drawings, wherein:

figures 1A-1C show an example of belt and operating unit of a sanding machine according to the prior art; figure 2 shows a schematic perspective view of a portion of a sanding machine according to the present invention; figure 3 shows a detailed side view of an assembly of the sanding machine of figure 2; figure 4A shows a side view of the assembly of figure 3 in a first configuration; figure 4B shows a side view of the assembly of figure 3 in a second configuration; figure 5 shows a schematic view of a second embodiment of the assembly in figure 3; figure 6 shows a schematic view of a third embodiment of the assembly in figure 3.

Detailed description

[0052] In the figures, similar parts will be indicated with the same reference numerals.

[0053] With reference to Figure 2, a sanding machine M is represented, object of the present invention.

[0054] Machine M is shown schematically; in particular, some mechanical components are not visible, as are most of the protective casings that normally surround and protect the machine, as they are not relevant to the intelligibility of the invention.

[0055] The machine M shown is a pass type sander, in which a panel P is placed on a transport system, for example a conveyor belt or roller, at an entry station (both not shown), according to the prior art.

[0056] The transport system advances the panel P along a first direction i, or advancement direction, and makes it pass under an operating unit so that at least one of its surfaces can be machined.

[0057] The operating unit of the machine M shown comprises a first roller 1 and a second roller 2, around which an abrasive belt (not shown) is inserted for processing the panel P.

[0058] Both rollers 1, 2 are able to rotate around their own axis.

[0059] The first roller 1 is oriented along a first axis, i.e. along a second direction j, transverse to the first direction i, while the second roller 2 is oriented along a second axis j', also transverse to the first direction i and substantially parallel to the second direction j.

[0060] The second roller 2 is a driving roller, moved by means of a motor apparatus (not shown) connected to the axis of the roller 2 itself, for example by belts; the first roller 1 is a driven roller, i.e. driven in rotation indirectly by the roller 2 by means of the abrasive belt inserted on the rollers themselves.

[0061] Furthermore, the machine M comprises a frame T to which the second roller 2 is coupled via a crossbar 21, which supports the weight of the operating group and fixes it rigidly so as to be able to machine the panel P transported underneath it.

[0062] The first roller 1 is coupled to the crossbar 21, therefore, to the frame T, via a support 11.

[0063] The crossbar 21 is part of the frame T of the machine M; in fact, the crossbar 21 is equivalent, in functional and structural terms, to a rigid and fixed element which supports the weight of the rollers and the operating group.

[0064] The support 11 is hinged to the crossbar 21, so that the first roller 1 is mobile around a third direction k, substantially transverse to the directions i, j.

[0065] Thus, roller 1 can rotate around the direction k, as shown by the double arrow F in Figure 2.

[0066] Similarly to the prior art, by means of this rotation of the roller 1 the alternate translations of the belt necessary to keep it in position during its circulation are induced.

[0067] Furthermore, the support 11 can be movable

along the direction k, to modify the distance between the axes of the rollers.

[0068] By way of example, the first roller 1 can be rotatably fixed in the middle, or at another point, such as one of its ends.

[0069] In addition, the machine M includes an actuator 3, coupled to the frame T and the support 11, to control the rotation of the support 11 itself, therefore, of the roller 1, around the third direction k.

[0070] Alternatively, actuator 3 can be coupled to frame T and roller 1, performing the same function.

[0071] Furthermore, the machine M comprises a sensor 4 to detect the position of the belt on the rollers 1, 2 during circulation, and a logical control unit U, operationally connected to the actuator 3 and to the sensor 4, according to the prior art.

[0072] Furthermore, according to the invention, the roller 1 is coupled to a damping device 5.

[0073] In the embodiment of Figure 2, the damping device 5 is rigidly fixed to the frame T of the machine M.

[0074] Reference is now made to Figures 3, 4A and 4B, which represent a side view of the assembly represented in Figure 2, to better describe the structure and operation of the machine according to the invention.

[0075] As can be seen in Figure 3, the actuator 3 comprises a chamber 30 and a piston 31, sliding inside the chamber 30 and coupled to a stem 32.

[0076] In the embodiment described, the actuator is of the pneumatic type; therefore, the chamber 30 is equipped with inlet and outlet lines 33 for the supply of air for the movement of the piston 31 in one direction and the other.

[0077] The fluid supply, therefore, the operation of the actuator 3 is controlled by the logical control unit U (not shown).

[0078] The actuator 3 is rigidly coupled to the support 11 of the roller 1 via the stem 32, and to the frame T of the machine in correspondence with the chamber 30.

[0079] The actuator 3 can be of the double-acting type.

[0080] The coupling to the T frame is represented schematically by hatching.

[0081] The damping device 5 of the described embodiment is a hydraulic damper, also comprising a chamber 50 and a piston 51, sliding inside the chamber 50 and coupled to a stem 52.

[0082] The support 11 of the roller 1 is slidably coupled to the stem 52 by means of a through opening 110, into which the stem 52 itself is inserted.

[0083] Furthermore, the stem 52 has a first abutment element 521 and a second abutment element 522, obtained at a predetermined distance, for example measured starting from the opposite faces of the support 11.

[0084] In this embodiment, the abutment elements 521, 522 are shoulders that act as mechanical stops to contain the relative movement of the support 11 with respect to the stem 52 of the damper 5.

[0085] For this reason, in alternative embodiments, the shoulders can be replaced, for example, by plates, wash-

ers, pins, screws or other types of elements applied to the stem 52.

[0086] The piston 51 has a hole 53 to allow the controlled transfer (leakage) of a fluid contained in the chamber 50.

[0087] The size of the hole 53 can be suitably modified to modulate the reaction force that the damper 5 opposes when the piston 51 is urged to move.

[0088] The damper 5 is also rigidly coupled to the frame T of the machine; the coupling is schematized again as a hatch that can be seen in Figures 3-4B.

[0089] It is now described in more detail the operation of the assembly shown in Figures 2-4B.

[0090] As mentioned, during the machining of a piece, the belt circulates on rollers 1, 2, which rotate around the respective j, j' axes.

[0091] Sensor 4 sends the unit U a signal corresponding to the axial position of the belt on the first roller 1 and/or on the second roller 2.

[0092] In one embodiment, the sensor 4 can be fixed to the crossbar 21, in a position corresponding to the initial equilibrium position of the belt when it is mounted in the machine.

[0093] The sensor 4 can be, for example, an infrared, ultrasonic or laser sensor.

[0094] In an embodiment in which a sensor 4 is present, this can be substantially facing a face of the belt and aligned with an edge, so as to detect axial movements of the belt itself along the j direction.

[0095] The distance between the shoulders 521, 522 defines a range of movement allowed for the support 11 around the initial equilibrium position of the roller 1, corresponding to the equilibrium position of the belt.

[0096] More in detail, it may happen that the belt, during machining, abandons its equilibrium position and moves axially, along the direction j, towards one end of the roller 1, entering the field of vision of the sensor 4.

[0097] When the logic unit U detects the presence of the belt in correspondence with the sensor 4, it sends a signal to the actuator 3 to move the roller 1 around the direction k and bring it to a first position inclined with respect to the equilibrium position, inducing a translation in the belt opposite along the j direction.

[0098] As previously said for the prior art, the inclination of the roller 1 preferably occurs in a horizontal plane, or even preferably perpendicular to the direction k.

[0099] In the example shown in Figure 4A, the actuator 3 is operated in extension according to the direction indicated by the arrow F1, by the entry of air into the chamber 30 as represented by the arrow A.

[0100] In this way, the belt translates axially and moves towards the opposite end of roller 1.

[0101] At this point, the edge of the belt comes out of the field of vision of sensor 4 and moves away from the equilibrium position.

[0102] Now referring to Figure 4B, the logic unit U receives a corresponding signal from the sensor 4 and consequently activates the actuator 3 in contraction accord-

ing to the direction indicated by the arrow F3, through the entry of air into the chamber 30 as represented by the arrow A.

[0103] Roller 1 rotates around the direction k and moves to a second position which is inclined in the opposite direction compared to the first position.

[0104] Contrary to the prior art, the extension and contraction stroke of the piston 31 inside the chamber 30, therefore also of the stem 32 and the support 11 coupled to it, is not limited in a fixed manner by external components mounted on the actuator 3 itself.

[0105] Instead, the extension and contraction of the piston 31 are limited by the respective shoulders 521, 522 present on the stem 52 of the damper 5.

[0106] In optimal operating conditions, the state of the belt allows its circulation to be regulated around the equilibrium position through rather frequent movements of roller 1, and then of actuator 3.

[0107] This means that the contact time of the support 11 with the shoulders 521, 522 is relatively short.

[0108] In fact, the longer the time that roller 1 spends in the first or second inclined position, the greater the distance traveled by the belt on roller 1 towards the respective end of roller 1.

[0109] Consequently, if the conditions of the belt are close to the initial ones of assembly in the machine, it is not necessary for the actuator 3 to remain in extension or contraction for prolonged periods of time, since the response of the belt to the inclination of the roller is almost immediate, and it can effectively translate around its equilibrium position with frequent and regular movements over time.

[0110] In fact, the conditions of the belt are close enough to the initial settings of the machine to require small corrections on the position of the belt itself on the roller, as it is not necessary to correct movements of the belt in one direction more than in the other.

[0111] In this situation, the construction characteristics of the damping device 5 mean that its response to the stresses deriving from the arrival of the support 11 at the stop is not immediate.

[0112] The support 11 (indirectly the actuator 3) applies a force on the stem 52 of the damper 5 for too short a time to produce an equally significant movement of the piston 51.

[0113] By their nature, in fact, hydraulic dampers exploit the viscous friction of the fluid contained within them to limit the speed of response to the stresses produced on the piston, through the application of a reaction proportional to the applied force.

[0114] As is known, short stress times have little effect on the movement of the piston, even if this corresponds to a considerable applied force; vice versa, it is possible to obtain a considerable displacement, even by applying a minimal force, as long as its application is prolonged over time.

[0115] Therefore, the movements of the stem 52, and therefore of the shoulders 521, 522, with respect to the

frame T of the machine remain rather limited, substantially negligible if the behavior of the assembly is considered over an extended time interval.

[0116] The average position of the ends that define the extension of the stroke of the actuator 3 remains substantially unchanged in space, compared to a fixed reference system such as, for example, the frame T of the machine M.

[0117] The result is that the behavior of the shoulders 521, 522 of the stem 52 allows simulating that of the fixed mechanical abutments of the prior art.

[0118] Advantageously, this allows the problem of effectively limiting the stroke of any actuator to be solved in a simple and economical manner.

[0119] In fact, it is possible to replace the shoulders 521, 522 with different, functionally equivalent abutment elements, as will be seen in detail in the embodiments described below.

[0120] In alternative embodiments, the damping device may also be different from a hydraulic damper, as long as it allows the same results described to be achieved.

[0121] Therefore, as mentioned, when the belt is replaced or suffers the effects of use or the surrounding environment, variations are generated (e.g., dimensional, structure), which modify the equilibrium position compared to the initial one.

[0122] As a consequence, the belt will tend to move faster towards one end of roller 1 than towards the other end.

[0123] In practice, since the equilibrium conditions have changed, the belt will tend to move axially along the roller 1 faster when the roller 1 itself is in a respective inclined position, compared to when it is in the other position.

[0124] For example, it may happen that the belt moves slower when the roller is in the first position and faster when it is in the second position, or vice versa.

[0125] In other words, for the same desired axial displacement of the belt on the roller to bring the belt back to the equilibrium position, the time that the roller itself will have to spend in the first position will necessarily be greater than the time spent in the second position, as the belt will move by the same distance more slowly while in the first position than in the second.

[0126] Due to this system imbalance, therefore, the actuator 3 will have to remain in the extended position (Fig. 4A) for a longer time, to allow the belt to return to the new equilibrium position resulting from the change in state of the belt itself.

[0127] In this condition, the application time of the force exerted by the actuator 3 on the stem 52 of the damper 5, via the support 11, is sufficient to move the piston 51 by a non-negligible distance.

[0128] This movement of the stem 52 of the damper 5, in fact, moves the extremes of the equilibrium position, represented by the shoulders 521, 522, towards the "new" equilibrium position.

[0129] The system, however, does not remain in this condition, but continues to alternate the passage of roller 1 between the first inclined position and the second inclined position.

[0130] With each subsequent movement towards the first position, the system will tend to progressively approach the new equilibrium position, until it reaches it.

[0131] After a certain number of movements, variable depending on the state of the belt and/or the components of the assembly, the stem 52 of the damper 5 will be in a position coinciding with that of equilibrium.

[0132] The stem 52 will be moved with respect to its initial position, as will the new interval around the equilibrium position of the belt.

[0133] The movements of actuator 3 become frequent and regular again over time.

[0134] Note that the stroke length of the actuator 3 is greater than the length of the distance interval between the abutments 521, 522, being comparable to the stroke length of the piston 51 of the damper 5.

[0135] In this way, advantageously, the invention is able to provide for the almost automatic adjustment of the machine, without the need for human intervention, nor to stop the machining of the pieces, nor to replace the components of the machine to adapt them to the new conditions.

[0136] The machine itself is able to adapt to the machining conditions that progressively derive from the state of the belt.

[0137] Figure 4B represents a situation similar to that described so far, in which the movement of the stem 52 of the damper 5 occurs towards the opposite direction to that of Figure 4A; actuator 3 remains in the contracted state for a longer time, and the equilibrium position shifts accordingly.

[0138] Referring now to Figure 5, an embodiment of the damping device 5 is shown as an alternative to the single hydraulic shock absorber, which allows the leakage of the fluid through a hole of suitable dimensions obtained in the piston.

[0139] The embodiment of Figure 5 involves the use of a damping device 6 comprising two shock absorbers 61, 62.

[0140] The shock absorbers 61, 62 can be, for example, hydraulic; below, the terms shock absorber 61, 62 and damper 61, 62 will be used in an equivalent manner to refer to the same respective elements.

[0141] The first shock absorber 61 comprises a piston 610, which delimits a first chamber 611 and a second chamber 612, both of variable dimensions depending on the position of the piston 610 itself, and coupled to a stem 613; the stem 613 comprises a first end 6131.

[0142] Similarly, the second shock absorber 62 comprises a piston 620, which delimits a first chamber 621 and a second chamber 622, both of variable dimensions depending on the position of the piston 620 itself, and coupled to a stem 623; the stem 623 comprises a first end 6231.

[0143] The respective first chambers 611, 621 of the two dampers 61, 62 are put into fluid communication by a first channel 54 for passing a fluid contained in the chambers themselves.

[0144] In the same way, the respective second chambers 612, 622 are communicated by means of a second channel 55 for passage of a fluid contained in the chambers themselves.

[0145] A valve 530 is positioned in one of the two channels to adjust the passage of fluid between the two respective connected chambers.

[0146] The dampers 61, 62 are arranged alongside the support 11, so that the respective pistons 610, 620 can move substantially along a direction parallel to the direction of movement of the actuator 3 (not shown), as described in the embodiment of Figure 2 -4B.

[0147] Furthermore, the dampers 61, 62 are arranged in such a way that the respective stems 613, 623 face towards the support 11.

[0148] In a similar way to what has been described so far, the support 11, therefore, the roller connected to it, is made to translate around an equilibrium position by the logic control unit (not shown), which controls the actuator (not shown) in one direction or the other, based on signals from a belt position sensor (not shown), as shown by arrow F5.

[0149] In the embodiment of Figure 5, the movement of the support 11 is limited by the presence of the stems 613, 623 of the respective dampers 61, 62.

[0150] In particular, each end 6131, 6231 of the respective stems 613, 623 faces towards the support 11.

[0151] In fact, the ends 6131, 6231 of each stem 613, 623 behave as abutment elements, defining the predetermined interval in which the support 11 can move.

[0152] As mentioned, if the equilibrium position of the belt shifts over time, requiring a shift in the permitted range of movement delimited by the stems, these tend to shift accordingly.

[0153] The movement is allowed by the fluid communication between the respective first chambers 611, 621 and between the respective second chambers 612, 622.

[0154] The leakage of the fluid caused by the valve 530 produces on the behavior of the dampers 61, 62 an effect identical to the effect that the hole 53 produces on the damper 5 of the embodiment of Figures 3-4B.

[0155] Consequently, a movement of the piston 610 of the first damper 61 towards one or the other direction will correspond to an equal movement of the piston 620 of the second damper 62, as indicated by the arrows F6, F7.

[0156] The distance between the ends of the stems 613, 623 facing the support 11, corresponding to the ends equidistant from the equilibrium position of the belt, will not change.

[0157] In fact, the single damper equipped with a chamber with two volumes communicating through a hole on the piston has been replaced with two dampers with separate chambers but connected via channels.

[0158] Advantageously, this embodiment also allows

the objectives of the invention to be achieved, overcoming the aforementioned drawbacks typical of the prior art.

[0159] With reference now to Figure 6, a third embodiment of the assembly of Figure 3 is described, according to the invention.

[0160] In this embodiment the roller 1 is coupled to a support 11, in a manner similar to that represented and described for Figure 2.

[0161] The assembly includes a double-acting actuator 3, comprising a chamber 30 within which a piston 31 slides.

[0162] The piston 31 also comprises a stem 32, equipped with a first portion 32a and a second portion 32b, each coupled to a respective face of the piston 31.

[0163] The first portion 32a includes a first end 321, the second portion 32b comprises a second end 322.

[0164] The chamber 30 of the actuator 3 is rigidly fixed to the support 11, and is equipped with inlet and outlet lines (not shown) for the supply of air for the movement of the piston 31 in one direction or the other.

[0165] Furthermore, the assembly comprises a damping device 5 comprising a chamber 50, within which a piston 51 slides.

[0166] The piston 51 further comprises a stem 52, equipped with a first portion 52a and a second portion 52b, each coupled to a respective face of the piston 51.

[0167] The first portion 52a comprises a first end 521, the second end 52b comprises a second end 522.

[0168] The chamber 50 of the damper 5 is also rigidly fixed to the support 11.

[0169] The piston 51 of the damper 5 comprises a through hole 53, to allow the leakage of the fluid into the chamber 50.

[0170] The assembly described is comprises in the space between two constraints, represented by a first wall 8 and a second wall 9, both of which are part of the frame T of the machine, therefore whose position is fixed.

[0171] The walls 8, 9 are arranged facing each other, where their distance is equal to the length of the stem 32 of the actuator 3.

[0172] In this way each end 321, 322 of the stem 32 of the actuator 3 is in contact at all times with a respective wall 8, 9.

[0173] The stem 32 is therefore blocked between the two fixed walls 8, 9 of the machine frame.

[0174] Consequently, the operation of the actuator 3 in one direction or the other will cause the translation of the components coupled to the chamber 30 of the actuator 3 itself, i.e. of the entire roller-support-damper assembly.

[0175] In this way, the rotation of the roller 1 around the k-axis of Figure 2 is obtained, which allows the belt to be maintained in the equilibrium position on the rollers, similarly to what was previously described.

[0176] The stem 52 of the damper 5, however, has a shorter length than the stem 32 of the actuator 3; in this way, it will be possible for the ends 521, 522 of the stem 52 to be facing, but spaced apart, with respect to the

walls 8 and 9.

[0177] In particular, the length of the stem 52 of the damper 5 is inversely proportional to the maximum stroke of the piston 31 of the actuator 3.

5 **[0178]** This maximum stroke, in fact, will be equal to the sum of the distances existing at any time between each end 521, 522 of the damper 5 and the respective wall 8, 9 towards which the end is facing.

10 **[0179]** In fact, the greater the length of the stem 52 of the damper 5, the smaller will be the maximum distance between each end 521, 522 and its respective wall 8, 9.

[0180] The behavior of the damper 5 is, in fact, similar to that described in the previous embodiments.

15 **[0181]** In optimal operating conditions, the state of the belt allows its circulation to be regulated around the equilibrium position through rather frequent movements of roller 1, and then of the actuator 3.

20 **[0182]** This means that the contact time of each end 521, 522 with the respective wall 8, 9 of the frame is relatively short.

25 **[0183]** Consequently, if the conditions of the belt are close to the initial ones of assembly in the machine, it is not necessary for the actuator 3 to remain in extension or contraction for prolonged periods of time, since the response of the belt to the inclination of the roller is almost immediate, and it can effectively translate around its equilibrium position with frequent and regular movements over time.

30 **[0184]** However, when the belt is replaced or suffers the effects of use or the surrounding environment, variations are generated (e.g. dimensional, structure) which modify the equilibrium position compared to the initial one.

35 **[0185]** As a consequence, the belt will tend to move faster towards one end of roller 1 than towards the other end.

40 **[0186]** Due to this system imbalance, therefore, the actuator 3 will have to remain in an extended or contracted position for a longer time, to allow the belt to return to the new equilibrium position resulting from the change in state of the belt itself.

45 **[0187]** In this condition, the application time of the force exerted by the actuator 3 on the stem 52 of the damper 5, via the support 11, is sufficient to move the piston 51 by a non-negligible distance.

[0188] This movement of the stem 52 of the damper 5, in fact, shifts the ends of the equilibrium position, modifying the distances between each end 521, 522 of the stem 52 and the respective wall 8, 9.

50 **[0189]** In particular, if the actuator 3 is operated to move the roller 1 to the right in Figure 6, the piston 31 moves relative to the chamber 30 towards the opposite direction, i.e. towards the left.

55 **[0190]** The distance between the first end 521 of the stem 52 and the wall 8 decreases until the end 521 and the wall 8 come into contact.

[0191] At this point, the application of a force by the actuator 3 continues over time, and the piston 51 of the

damper 5 moves in a direction consistent with the direction of movement of the piston 31 of the actuator 3, i.e. also towards the left.

[0192] The system, however, does not remain in this condition, but continues to alternate the passage of roller 1 between the first inclined position and the second inclined position.

[0193] With each subsequent movement towards the first position, the system will tend to progressively approach the new equilibrium position, until it reaches it.

[0194] After a certain number of movements, variable depending on the state of the belt and/or the components of the assembly, the damper 5 and the respective support 11 and roller 1 will be in a position coinciding with the "new" equilibrium position.

[0195] The working positions of actuator 3 will move accordingly.

[0196] In particular, the working positions of actuator 3 and damper 5 will be moved compared to their initial position, as will the new interval around the equilibrium position of the belt.

[0197] In particular, the distances between the respective chambers 30, 50 of the actuator 3 and the damper 5 with respect to the wall 8 in the new equilibrium position will be greater than the same distances corresponding to the initially set equilibrium position.

[0198] Conversely, the distances between the respective chambers 30, 50 of the actuator 3 and the damper 5 with respect to the wall 9 in the new equilibrium position will be smaller than the same distances corresponding to the initially set equilibrium position.

[0199] In other words, the piston 51 of the damper 5 will have moved to the left compared to the initial equilibrium position.

[0200] This is how the movements of actuator 3 return to being frequent and regular over time, but limited to an interval different from the initial one.

[0201] Still referring to Figure 6, an alternative embodiment of the invention comprises a blocking device 7.

[0202] The blocking device 7 comprises a slide 71, rigidly fixed to the support 11, and a slider 72, constrained inside the slide 71 so as to slide along a direction substantially parallel to the direction of sliding of the stems 32, 52 of the actuator 3 and the damper 5.

[0203] The slider 72 has a length equal to the length of the stem 52 of the damper 5, and comprises a first end 72a and a second end 72b.

[0204] The first end 72a faces the wall 8 of the machine frame, while the second end 72b faces the wall 9 of the machine frame.

[0205] The position of the slider 72 with respect to the guide 71 is adjustable; in particular, it is possible to block the slider 72 so as to allow the movement of the support 11 between the walls 8, 9 of the frame within a fixed interval.

[0206] By blocking the position of the slider 72 with respect to the slide 71, in fact, the movement of the support 11 around between the walls 8, 9 is limited by the

slider 72 itself, which comes into contact with one or the other wall when the actuator 3 is operated.

[0207] Consequently, the damper 5 will not be able to accompany the movement of the support 11.

[0208] The blocking device 7 described can also be installed in alternative embodiments to the one just described.

[0209] The blocking device 7 is particularly useful if it is decided to maintain the configuration of the assembly in a given position if interventions on the machine become necessary which could modify the positions of the damper, actuator, etc.

[0210] In alternative embodiments, it is possible to use two or more actuators to move the roller or support.

[0211] It is clear how the present invention allows the aforementioned objectives to be achieved, in particular thanks to the fact that the position of the predetermined range of movement of the roller, or support, with respect to the machine frame is variable.

[0212] Specifically, it is possible to modify, without the need for intervention by an operator, the position of the extremes of said interval, with respect to a fixed reference point, for example the machine frame, in order to accommodate variations in the equilibrium position of the belt on the rollers due to changes in its state.

[0213] The present invention has been described for illustrative but not limitative purposes, according to its preferred embodiments, but it is to be understood that modifications and/or changes can be introduced by those skilled in the art without departing from the relevant scope as defined in the enclosed claims.

Claims

1. Machine (M) for machining workpieces (P), comprising a frame (T),

a device for transporting workpieces (P) to be machined along a first direction (i),
an operating unit for machining the workpieces (P), said unit including

a first roller (1) and a second roller (2), rotating around an axis oriented along a second direction (j) transversal to the first direction (i), and configured to support and move a belt for machining workpieces (P),
a crossbar (21) supporting said first (1) and second (2) rollers, wherein

the crossbar (21) is rigidly fixed to the frame (T) of said machine (T), and
wherein the first roller (1) is coupled to said crossbar (21) so as to rotate around a third direction (k) transversal to the first (i) and the second direction (j),

- said machine (M) comprising an actuator (3) coupled to said frame (T) and to said first roller (1), so as to rotate, when actuated, the first roller (1) around said third direction (k),
characterized in that it comprises a damping device (5; 6) coupled to said frame (T) and to the first roller (1), and configured to limit the movement of the first roller (1) around the third direction (k) within a predetermined range.
2. Machine (M) according to the preceding claim, **characterized in that** it comprises
- a sensor (4) and
a control logic unit (U) operatively connected to the actuator (3) and to the sensor (4), wherein the sensor (4) is configured to send to the control logic unit (U) a signal associated with the position with respect to the axis of a belt running on the first (1) and/or on the second (2) roller, and
wherein the control logic unit (U) is configured to operate the actuator (3) and rotate the first roller (1) around the third direction (k), to maintain a circulating belt in a predetermined equilibrium position with respect to the axis of the first (1) and/or of the second roller (2).
3. Machine (M) according to any one of the preceding claims, **characterized in that** said damping device (5; 6) is configured so that the position of said predetermined interval with respect to the frame (T) of the machine (M) is variable.
4. Machine (M) according to any one of the preceding claims, **characterized in that** it comprises
- a support (11) coupled to the first roller (1), rotatably coupled to said crossbar (21), and slidably coupled to said stem (52), and
in that the damping device (5; 6) comprises a first abutment element (521; 6131) and a second abutment element (522; 6231) for the support (11), which define said predetermined interval of movement of the first roller (1) around the third direction (k).
5. Machine (M) according to the preceding claim, **characterized in that** the first roller (1) rotates around the third direction (k) between a first position, in which the support (11) is located near the first abutment element (521; 6131), and a second position, in which the support (11) is located close to the second abutment element (522; 6231).
6. Machine (M) according to claim 4 or 5, **characterized in that** the damping device (5; 6) comprises at least one chamber (50; 611, 612, 621, 622) containing a fluid, a piston (51, 610, 620) slidably constrained in said chamber (50; 611, 612, 621, 622), and a stem (52; 613, 623), wherein the first roller (1) is configured to abut with at least a portion of said stem (52; 613, 623).
7. Machine (M) according to claim 2 or 3, **characterized in that** it comprises a support (11) coupled to the first roller (1), rotatably coupled to said crossbar (21) and slidably coupled to said stem (52), and
in that the damping device (5) comprises a chamber (50), a double-acting piston (51), slidably constrained in said chamber (50), and a stem (52) comprising a first portion (52a) and a second portion (52b) arranged on opposite faces of the piston (51), wherein the chamber (30) of the actuator (3) and the chamber (50) of the damping device (5) are rigidly coupled to the support (11), and wherein the first (52a) and second (52b) portions of the stem (52) of the damping device (5) face respective portions (8, 9) of the frame of the machine (M) and define said predetermined range of movement of the first roller (1) around the third direction (k).
8. Machine (M) according to claims 6 or 7, **characterized in that** the piston (51) comprises a through hole (53) for the leakage of said fluid.
9. Machine (M) according to any one of claims 4-6, **characterized in that** the damping device (6) comprises
- a first shock absorber (61) comprising a first piston (610) sliding so as to define a first chamber (611) and a second chamber (612), both containing a fluid, and equipped with a first stem (613),
a second shock absorber (62) comprising a second piston (620), sliding so as to define a respective first chamber (621) and a respective second chamber (622) both containing a fluid, and equipped with a second stem (623), wherein the first chambers (611, 621) and the second chambers (612, 622) are respectively in fluid communication by first (54) and second (55) channels, and wherein the first (613) and second stem (623) face the support (11) and respectively comprise the first (6131) and second abutment element (6231) for the support (11).
10. Machine (M) according to claim 7, **characterized in that** it comprises a blocking device (7) comprising a

slide (71), rigidly fixed to the support (11), and a slider (72), slidably connected to the slide (71), and comprising a first end (72a) and a second end (72b), each one in contact with a respective portion (8, 9) of the frame (T) of the machine (M), and wherein the slider (72) position with respect to the slide (71) is reversibly blockable, so that said predetermined range of movement of the first roller (1) around the third direction (k) is fixed.

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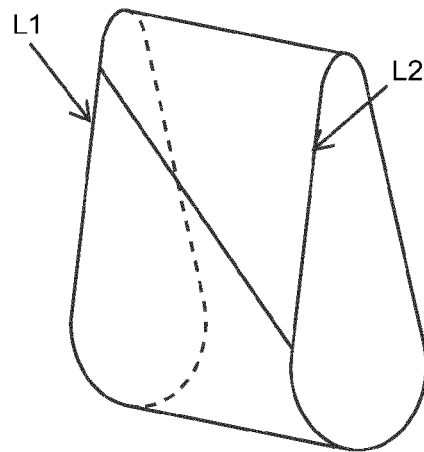


Fig. 1A
PRIOR ART

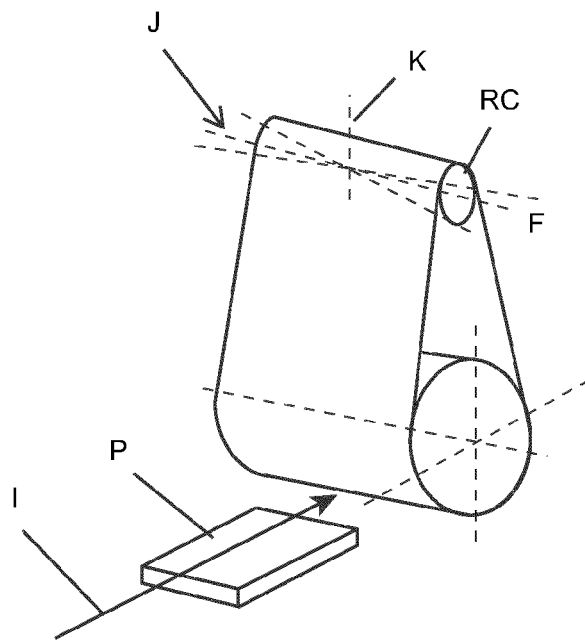


Fig. 1B
PRIOR ART

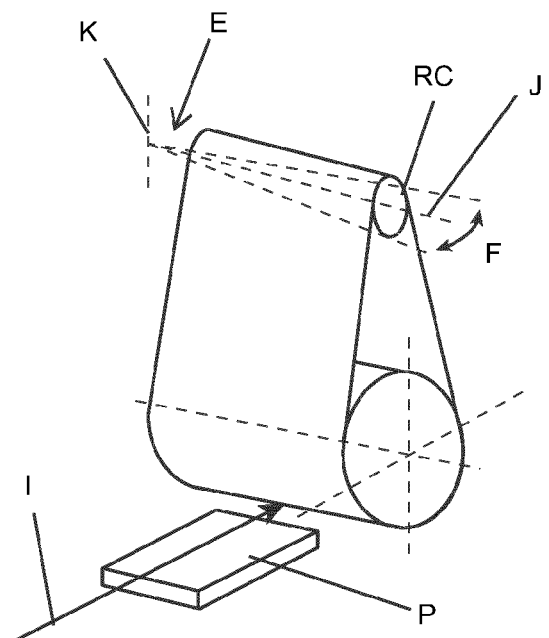


Fig. 1C
PRIOR ART

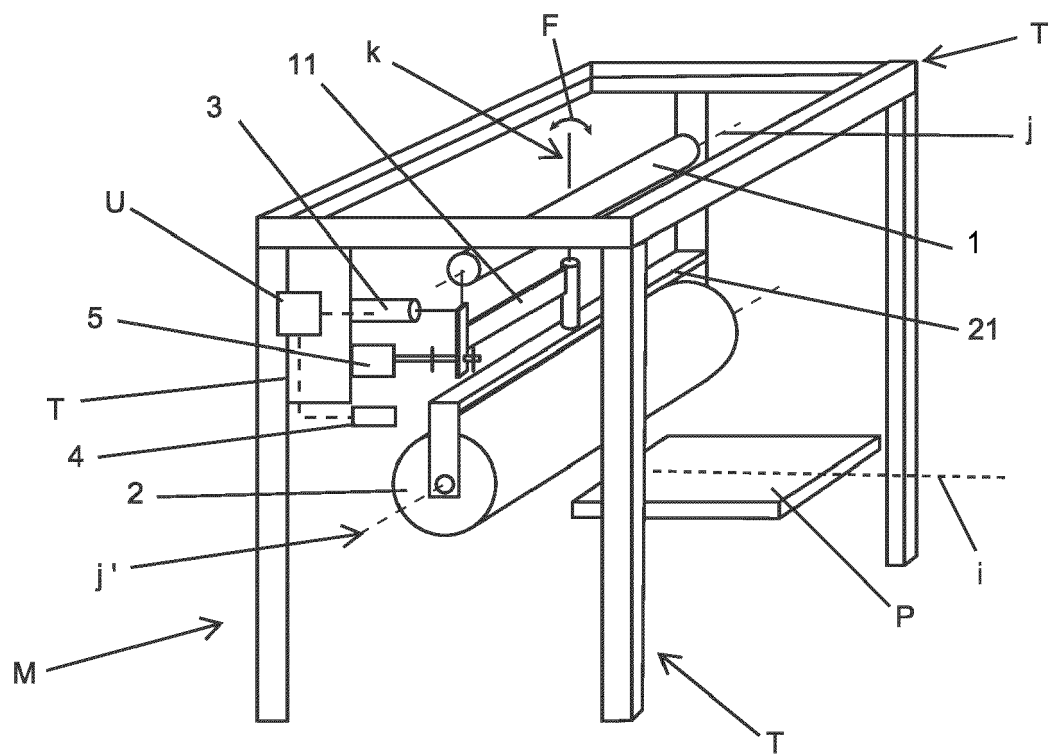


Fig. 2

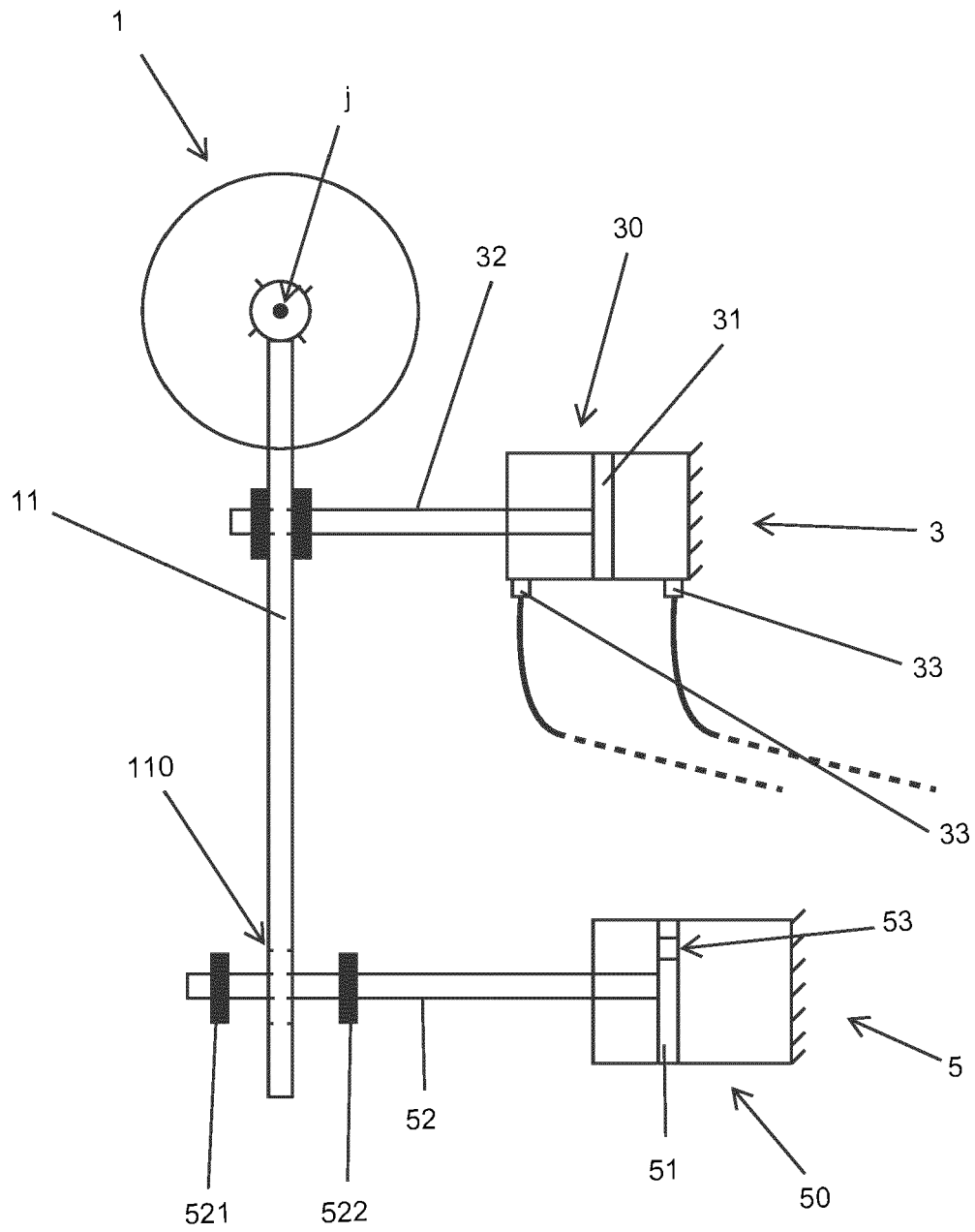


Fig. 3

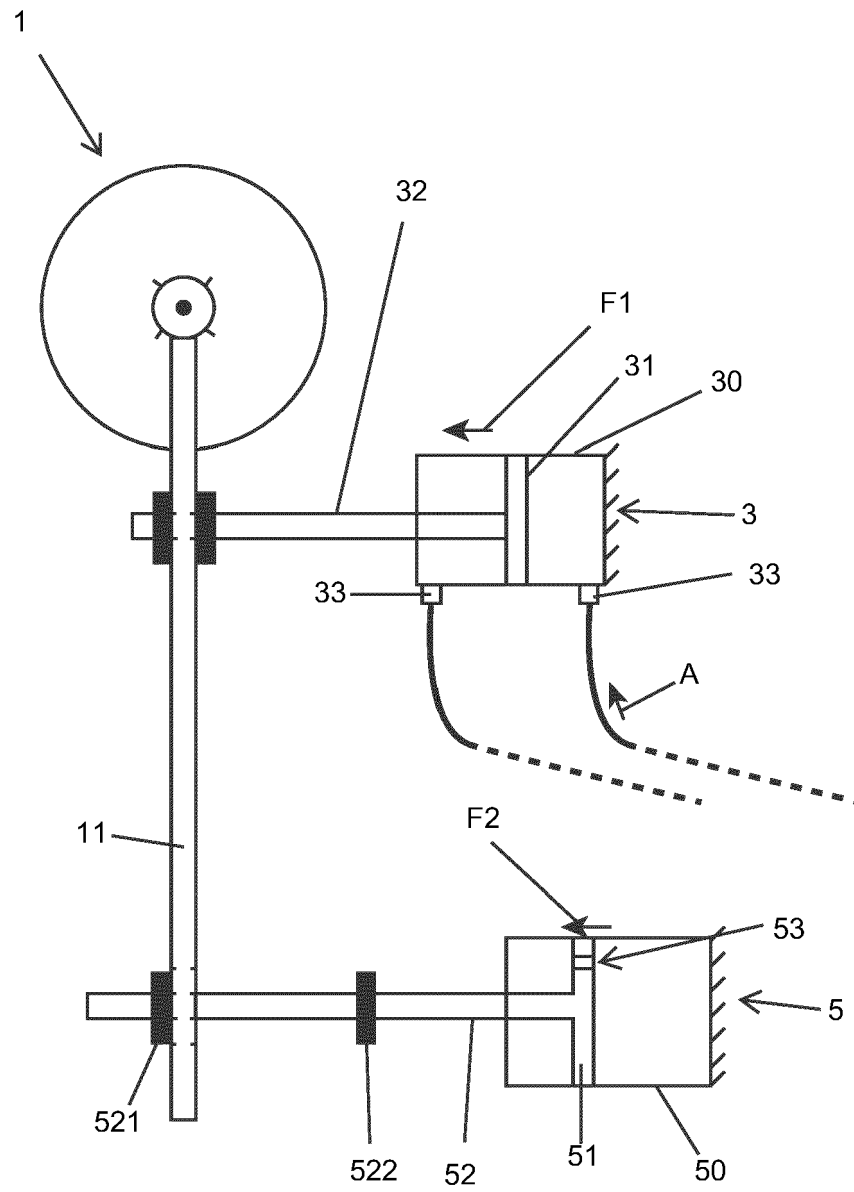


Fig. 4A

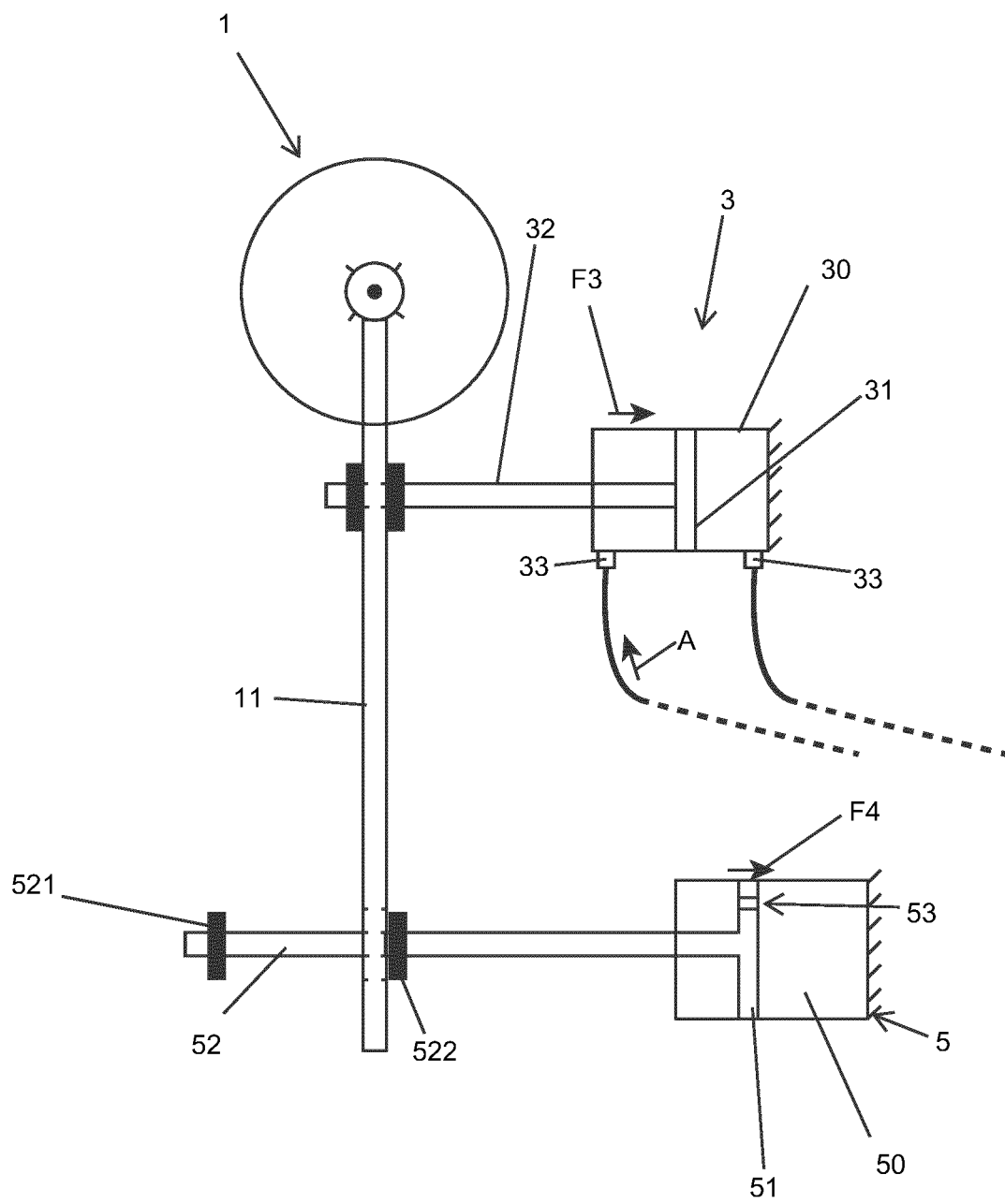


Fig. 4B

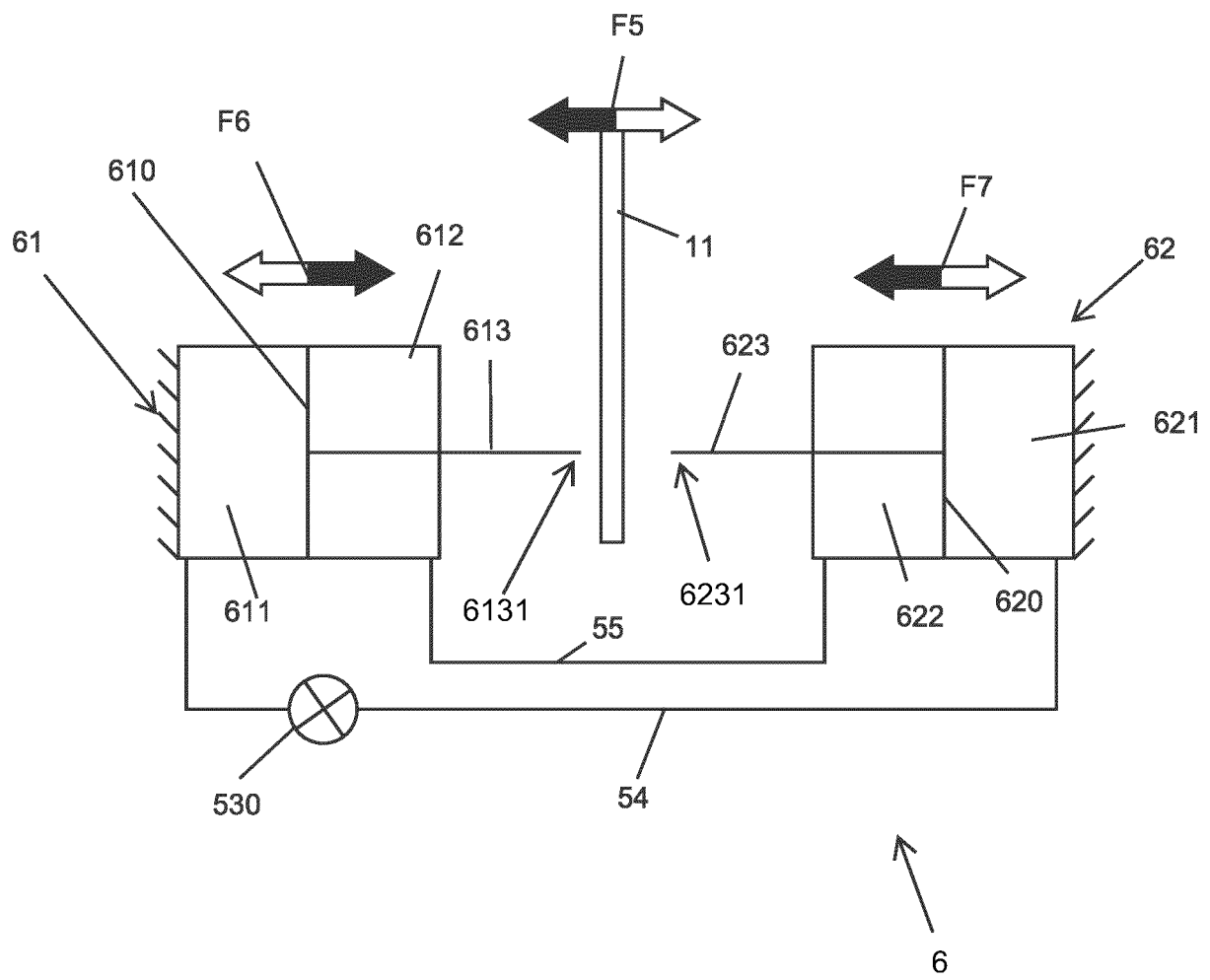


Fig. 5

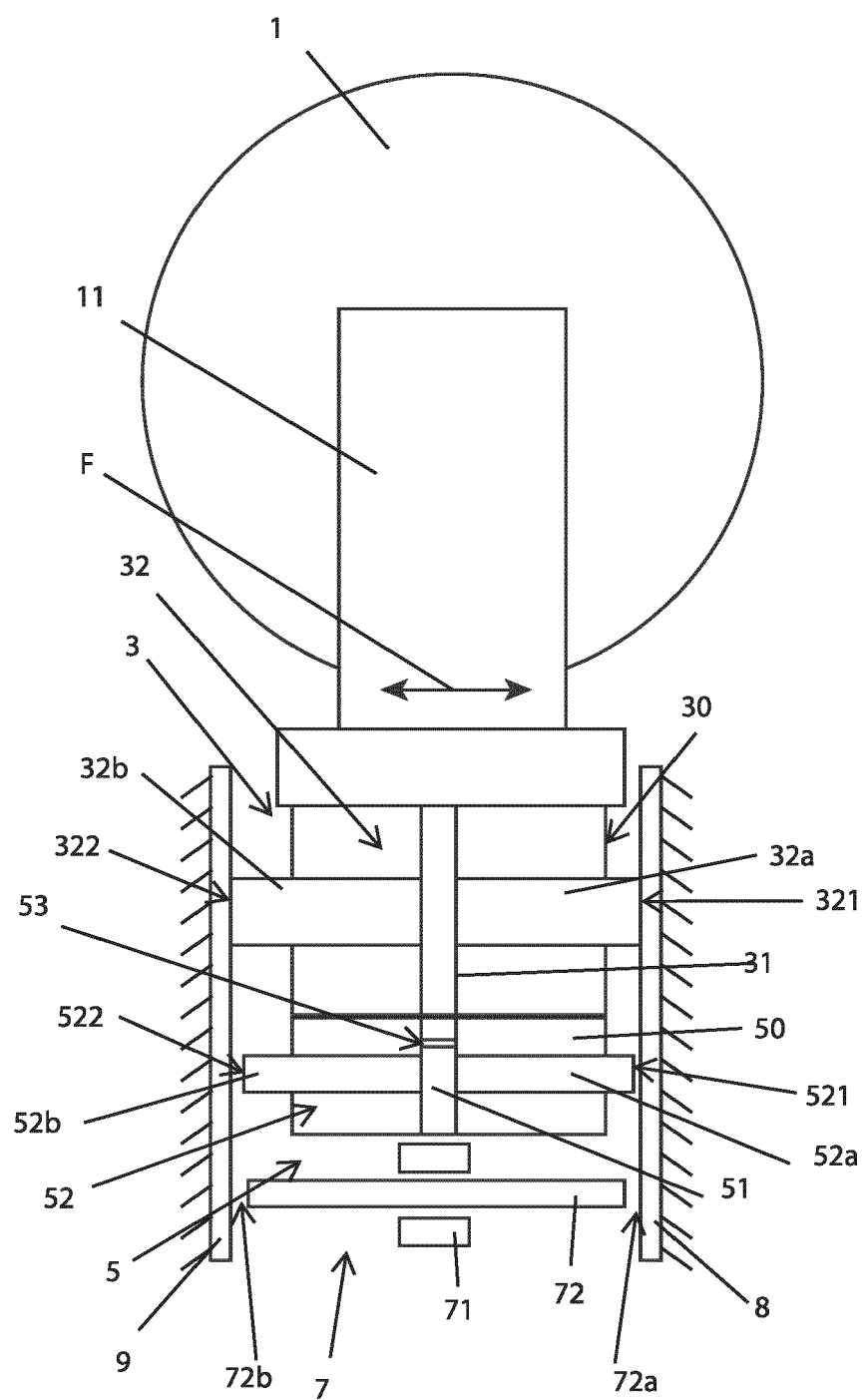


Fig. 6



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A	* paragraph [0010] *	4-10	B24B41/00
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	* paragraph [0050] *		
	* paragraph [0054] *		
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	* claim 1 *		

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Place of search Munich		Date of completion of the search 11 September 2024	Examiner Arhire, Irina
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T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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